Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LIV. NEW YORK, THURSDAY, SEPTEMBER 23, 1909. No. 13.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.
239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....590 Old Colony Building
CLEVELAND OFFICE.....1015 Schofield Building
PHILADELPHIA OFFICE.....Real Estate Trust Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico.....per year, $3.00
Dominion of Canada.....per year, 4.50
Other Foreign Countries within the Postal Union.....per year, 6.00
25 shillings. 25 marks. 31 francs.

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1908, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Thursday of the same week.

Copyright, 1909, by MCGRAW PUBLISHING COMPANY.

Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1908 was 898,000. Of this issue 16,250 copies are printed.

NEW YORK, THURSDAY, SEPTEMBER 23, 1909.

CONTENTS.

Editorial 693
A Patent Office Abuse 698
Convention of Car-Lighting Engineers 698
Convention of Illuminating Engineering Society 698
Educational Plans of the Baltimore N. E. L. A. Section 699
Chicago Street Railway Labor Dispute Settled 699
Water-Power Development at Oregon, Ill 699
Proposed Unification of Railroad Terminal Facilities in Chicago 699
Joint Convention of Northwest Electric Light and Power Association and Seattle Section of A. I. E. E. 700
Annual Meeting of the Vermont Electrical Association 701
Public Service Commission Hearing on Meter-Test Reports 703
Massachusetts Commission News 703
New York Public Service Commission News 704
Electric Freight Locomotives for the New Haven Railroad 704
Current News and Notes 705
Hydroelectric Development on the Wisconsin River, Near Kilbourn, Wis. 707
Self-Starting Single-Phase Motor 711
Oakland (Cal.) Steam Auxiliary Station for Great Western Power Company 712
White Light from the Mercury Arc and Its Complementary. By Herbert E. Ives 714
Luminosity and Temperature. By P. G. Nutting 715
Design of Illuminating Installations Using Luminous Tubes. By M. D. Cooper 718
Producer Gas Plant at St. Joseph, Mich 722
Central-Station Exhibits at Canadian National Exhibition 722
Figures from the Iola (Kan.) Central Station 722
Recent Extensions of Central-Station Service in Chicago 723
Power Used in the Manufacture of Lumber 724
Care of Tungsten Street Lamps 726
Albany Park Ornamental Street Lighting 726
An Experimental Study of the Globe Photometer. By A. A. Perrine. 727
New Telephone Patents 728
LETTERS TO THE EDITORS:
Alternating-Current Waves. By Henry Hermann 729
Movement of Magnetic Material in a Rotating Field. By C. W. Lange 730
Time-Phase Relations in Three-Phase Systems. By John Gilmartin. 730
Digest of Current Electrical Literature 730
New Apparatus and Appliances 735
Industrial and Commercial News 737
General News 742
Weekly Record of Electrical Patents 749

CONVENTION OF ILLUMINATING ENGINEERING SOCIETY.

The annual meeting in New York next week of the Illuminating Engineering Society promises to score a success that will even overtop the high record set by the Philadelphia convention of last year. While the Hudson-Fulton celebration is not a negligible factor in the anticipations of large attendance, the program of papers, which is printed elsewhere, fixes in advance the high character of the meeting. The reports to be presented of the several committees dealing with nomenclature and notation, unit of light and photometric units are looked forward to with much interest. The young society scored a distinct triumph through the recent adoption by this country, France and Great Britain of a common unit of candle-power, which was the result of a movement initiated by it. There remains, however, a great field of work in setting in order the nomenclature and notation of illuminating engineering, and in placing on a satisfactory basis both the scientific and practical sides of photometry. Among the papers to be presented, at least four promise to be contributions of high interest to their several subjects, namely, the light of the firefly, by Drs. Ives and Coblentz; shades and reflectors, by Dr. Bell; heterchromatic photometry, by Mr. Preston S. Millar, and factory lighting, by Messrs. Marks and Woodwell. The lecture by Dr. Steinmetz on the physiological aspect of illumination will round out a program of exceptional interest and merit.

A HYDROELECTRIC PLANT AT LOW HEAD.

The Kilbourn (Wis.) transmission plant, described elsewhere in our columns, is chiefly notable as a successful attempt to deal with a relatively low head in a necessarily variable stream. As rivers go, the Wisconsin is fairly steady, but it suffers from floods to an extent that has made it necessary to resort to considerable reduction of head. The normal head is 17 ft., and the desirability of using large generator units—in this instance 1500 kw—compelled the employment of a multiplicity of wheels—six, in fact—on each of the horizontal generator shafts, each giving about 450 hp at the full head, or about 270 hp at the reduced head of 12 ft. which may now and then be encountered. This arrangement implies a rather elaborate hydraulic plant, but the multiplicity of wheels was required to get even the required 100 r.p.m. of the driving shaft. A somewhat unusual feature is the construction of the penstock from reinforced concrete, forming vaulted structures in which the runners are submerged. Above each pair of runners is a sort of umbrella, a curved steel roof so shaped as to give steady admission of water to the wheels without the formation of vortices and the entraining of air thereby. By this device the horizontal turbines can be set higher, so that the power-house design is simplified. Extra powerful governors are applied to control the turbines, so that even at this low head good regulation is attainable. In this particular the extremely free delivery of water to the wheels goes to compensate for the masses to be handled.

The concrete dam has a movable crest consisting of vertical steel sliding gates operating between concrete piers rising above the normal crest of the dam. There are 12 of these gates operated from a long motor-driven shaft by independent clutches. The power house itself, aside from its turbine equipment, is of rather canonical design with its four 1500-kw three-phasers and pair of water-wheel driven exciters. The transmission line proper is 70 miles long, joining, however, another 50-mile line into Milwaukee. It is at present worked at 44,000 volts, although provision has been made for going to 70,000 later. The line is in duplicate, but carried on a single tower line with suspension insulators, having three bells in series and tested at 75,000 volts dry and 53,000 volts under spray test. The towers are spaced 10 per mile, and the wires of each circuit are spaced vertically at 72 in. between wires. The periodicity is 25, much of the power being intended for delivery to the Milwaukee Electric Railway & Light Company. The plant is a capital instance of exceptional hydraulic requirements met with great resourcefulness, coupled with a good but utterly commonplace electrical equipment. Ten years ago a 44,000-volt plant would have attracted great attention, but so rapid has been the progress of power transmission that such an outfit has degenerated into the ordinary and hardly draws a paragraph outside of the local newspapers. Truly the world has been moving rapidly of late.

The Synthesis of White Light.

An article by Dr. Ives, printed elsewhere, gives the result of some experiments on the synthesis of white light from the mercury arc and divers other illuminants. The mercury arc is so lacking in red that no practicable kind of screening can possibly produce from it white light without blocking off a very large proportion of the total luminous radiation. Even the quartz-mercury arc, which to the eye is far nearer to white than the ordinary form, is quite hopeless for proper color vision, and all attempts to modify the radiation by additions to the active material in the tube have thus far ended in failure. The expedient tried by Dr. Ives is in general a familiar one, consisting in adding to the mercury light rays from a source rich in red. The ordinary incandescent lamp has been tried in this function by various experimenters, and the especial interest of Dr. Ives' work lies in his application of tungsten lamps and Welsbach burners to the same service. The Maxwell color triangle in the form given, by the way, must be considered as merely diagrammatic except for the conditions of the Ives experiments. As ordinarily given it is neither equilateral nor really bounded wholly by straight lines. When one forms, however, his equations for white in terms of the primaries, the corresponding color triangle is a very convenient way of getting at graphical results.

It must be remembered in this connection that there is very little agreement as to what constitutes normal white. Abney, Nichols and Ives disagree widely in their "white" equations, and in reading this paper it should be noted that Ives' white would be called bluish white by the others. This word of explanation is necessary in order to understand the possibility of getting anything approximating "white" from a combination of a mercury arc and a Welsbach burner, both of which are relatively weak in red. Ives himself states that the "white" thus obtained is a little greenish, while in terms of Nichols' results it would be conspicuously blue-green. It is quite evident that the variations in defining white are large compared with the quantities here dealt with. The tungsten lamp gives, from Dr. Ives' figures, a somewhat pinkish-white, but evidently either tungsten or Welsbach is a valuable addition to the mercury arc in ameliorating the color, which is the important practical consideration. Such mixtures gave fairly good color-rendering results, with some deficiencies apparently due to the still rather discontinuous character of the combination spectrum. In trying to use such a combination it would probably be best to put both sources behind the same diffusing screen, or otherwise in such relation that the two lights would not act upon the eye as independent sources, else one would expect some bizarre subjective effects. In fact, when a mercury arc is used with ordinary incandescents, both being visible, the former seems quite to dominate the latter, perhaps from attracting undue attention to itself. It seems likely that a mercury arc with slight selective screening would give a still better result with tungsten lamps, while still possessing a high working efficiency. Tungsten lamps alone are distinctly deficient in blue, and the combination would certainly give much higher efficiency than any selective screening of the tungsten.

Illumination Obtained from Luminous Tubes.

The relation existing between the rated candle-power of a tube lamp and the illumination obtained from such a lamp upon a plane lighted by it, is well discussed in an article by Mr. M. D. Cooper which appears elsewhere in this issue. The author assumes that the radiating section of the lamp is composed of an infinite number of lines of light parallel to the axis of the tube, and that the candle-power of each line is proportional to its length. On the basis of this assumption, the density of illumination in foot-candles over the whole reference plane is explored by means of the well-known inverse-square and cosine relations. In the application of the author's conclusions it should be kept in mind that he has tacitly assumed black ceiling, walls and floor. Having ignored the light that will be reflected from the walls and ceiling to the reference plane, his error is on the safe side, but would evidently be very large in the case of white walls and ceiling frequently used with tube-lighting installations.

Attention should be called to a method of treating the problem relating to tube lamps which may prove more convenient than the one explained by Mr. Cooper, and will usually involve less error when practically applied. The lamp may be treated as the source of a certain number of lumens per foot, there being, of course, 4π lumens per mean spherical candle-power. Depending upon the mechanical arrangement of the lighting equipment, a certain portion of these lumens are directed toward the walls, another portion toward the ceiling, and the remainder toward the floor. When all of the surfaces can be considered black, the average intensity of illumination on each in foot-candles can be found by dividing the value of lumens directed toward this surface by the area in square feet. When only the floor is black, and the other surfaces are perfect reflectors, the floor illumination equals the total value of lumens from the lamp divided by the area of the floor. Neither the former condition nor the latter is found in practice, but the actual illumination will frequently have a value nearer that determined from the latter assumption than that from the former

The true value for the total lumens reaching the floor can be determined by subtracting from the amount last stated the lumens absorbed by the walls and ceiling. The absorption of light by the latter surfaces can be calculated at once when the value of the incident lumens is multiplied by the proper absorption coefficient. In many cases the effective illumination can most conveniently be determined with a good degree of accuracy by using the absorption-of-light method of calculation, and dealing with the output from the lamps as a certain number of lumens, rather than employing the more laborious methods based upon candle-power measurements and neglecting the large amount of reflection from the ceiling and walls.

LUMINOSITY AND TEMPERATURE.

The complications encountered when one attempts to express in the form of an equation the relation existing between luminosity and temperature will be appreciated when consideration is given to the involved relation between temperature and total radiation, and the even more complex relation between total radiation and visible radiation, or luminosity. The desired equation would represent the product of a radiation-temperature equation and a luminous-efficiency value, radiation being the common term connecting the two expressions. At the present time the laws interconnecting radiation with temperature and with luminosity are so imperfectly understood that the only equations available must be considered largely empirical as to form and wholly so as to constants. However, during the last few years a large amount of experimental work has been done with radiation phenomena, and many of the data have been interwoven into intelligible expressions of actual relations. The better understood relation, and the one based more nearly on facts that may for a time be considered fundamental, is that dealing with temperature and total radiation; on the other hand, the luminous efficiency depends upon many imperfectly understood phenomena, such as selective emission and color sensation. In the article by Dr. P. G. Nutting, which appears in this issue, there is given an outline of the equations that have thus far been developed and the most reliable constants that have been ascertained by careful investigations. It is encouraging to find that the resultant equation indicates values that accord closely with facts as they exist with commercial luminous radiators, such as the filaments of carbon, tantalum, tungsten and osmium lamps. In this connection it is interesting to make note of certain relations that have not been established as fundamental but have a direct bearing on the facts discussed above—namely, that the substances that transmit light readily are non-conductors of electricity, while metals that possess a high electrical conductivity possess also a high reflecting power.

SOME PHENOMENA OF THE INCANDESCENT FILAMENT.

It was discovered by Edison nearly thirty years ago that when a metallic plate is supported in the bulb of an incandescent lamp, and a sealed-in wire brings out electric connection with the same, an electric current tends to flow from the plate to the negative end of the filament during the incandescence of the latter. In other words, when the filament is cold, the plate remains insulated by the vacuous space within the bulb, but when the filament incandesces, this space conducts in one direction. It is now regarded that the glowing filament discharges negative electrons in all directions, and that if the metallic plate is suitably connected outside, a considerable number of these electrons can be made to impinge upon and bombard the plate, delivering up their negative charges as they strike, and so keep up a steady electric current. This curious property of an incandescent cathode in a vacuum tube has been applied in wireless telegraphy to the production of a receiver. Incoming electric oscillations at the receiving mast are led to the anode of a vacuum tube so as to produce additional bombardment of the same from a steadily incandescent cathode. The accompanying charge of electric current is manifested to the senses in a telephone or other appropriate receiver.

The August number of the *Physical Review* contains a paper, by Mr. Orin Tugman, on this subject, as illustrated by laboratory investigation. The incandescent lamp was of a special form, which permitted the anode metallic plate to be advanced toward or receded therefrom within a fairly considerable range. The anode could be maintained at a constant potential, with respect to the filament. Adjustable up to 110 volts and, superposed upon this constant potential, was an oscillatory potential of high frequency from a sort of wireless telegraph apparatus. The conditions of the experiment permitted of variation in regard to several independent variables. The degree of incandescence of the filament could be varied by altering the local current through the same. The degree of vacuum could be varied. The distance between anode and filament could be varied at will, and the potential steadily impressed on the anode and cathode could be changed. The results indicate, as might be expected, that the phenomenon is a complicated one, and far from being completely explained or predicted at present. In general, however, it appears that as the potential-difference between anode and cathode is increased, the cathode-ray current increases up to a saturation point beyond which but little increase of current occurs with any moderate increase in potential. If electric oscillations are superposed, they tend to increase the current if the latter is below the saturation value, but to decrease it if saturation has been passed. Consequently, for one particular value of impressed potential difference near saturation, the effect of superposed electric oscillations is nil.

The effect of distance between anode and cathode is reported as being very marked. The current increased with distance up to a rather sharp maximum at about 1 cm, and then fell off rapidly. In some instances a second maximum developed. Curiously enough, all effects were observed to dwindle as the age of the filament increased. This suggests that a new incandescent filament produces more electrons and cathode-ray discharge than an old incandescent filament operated at the same temperature. If that is the case, chemical as well as physical changes may be expected to occur in the external layers of filamentary material. These changes would seem to complete themselves on the development of a high temperature and to become exhausted as time goes on.

THE STANDARD OF LIGHT.

Sufficient progress with an international candle has now been made to justify some attempt at a uniform terminology among writers on photometric subjects. With Great Britain, France and the United States in full accord on a common unit of light, and one that bears a very simple relation to the customary German unit, the time is ripe for further steps. The reply of the German Committee of the International Electrical Com-

mission to the general body on the proposition gives promise of friendly co-operation. Their objection to a formal adoption of the proposed candle, however, seems to arise from a fundamental misunderstanding. It would probably take 10 years at least to get the various official laboratories into accord on an international candle, and 10 years more of confusion is an intolerable proposition. Our German friends seem again to have confused the question of unit with that of a concrete physical standard. The laboratories of various countries could well spend years in attempted settling of the latter affair and then fail to come to an agreement. There was no intention in the proposals now adopted of forcing the German hand. The situation was merely this, that the legal so-called candles of the three great countries acting were not in accord, but still were near enough together to be brought to a common basis without serious commercial difficulty. So the thing was done and, in fact, the common value was that of the *bougie decimale*, the only unit that has ever had anything like international endorsement, and the first scientific unit adopted in photometry.

The common German unit, which happens to be the equivalent of the usual German primary standard, was obviously too different from the units of the three other powers concerned to permit of any compromise value, but it fortunately led to a very simple ratio, which is the next best thing to agreement. And with the German committee adopting provisionally this ratio, the whole affair is left in good working shape for practical purposes. We are most heartily in accord with the German's criticism of the heterogeneous units of length that appear in photometry. We never heard of the yard-candle to which they refer being used, but some advocate of ancient mythology may have at some time been guilty of it. The meter-candle is undeniably the only one for international purposes, and while the foot-candle may die hard, its days are numbered. We do not hesitate to say that the American photometricians will be found a unit for the meter-candle when the time comes for action. Our German confrères can on their part do sterling service to the cause of progress by straightening out the confusion which now exists in their use of *kerze* in such connection. Meter-kerze and meter-hefner are now often used without proper distinction among the less careful writers. There was a German candle not long ago to which *kerze* properly belonged, and careful writers quite generally write H.K. when the hefner is employed as a unit. When this difficulty is cleaned up, the matter of units can be considered as in fairly good practical condition.

Rather recently some German writers have fallen into the quite inexcusable custom of adopting the term *lux* for the meter-hefner. Now, as a matter of scientific propriety based on the origin of the term and its coming into use, lux can rightfully mean but one thing, i. e., the *bougie-meter*, as laid down by Professor Blondel in 1893, when for the first time a systematic system of photometric units was set forth. The term lux now applies rightfully, therefore, also to the international meter-candle, which is the same thing as the *bougie-meter*. It would be highly desirable to confine, therefore, the unqualified use of the word lux to this value and to use hefner-lux (H.L.), like H.K., if that is the unit meant. There is not any serious objection to the use of hefner, or carcel, whenever convenient, and it must be realized that the German lamp industry has so grown up with the hefner as a unit that a change involves some difficulties. But there is no reason for confusing it with the larger candle unit through the slipshod use of terms, and there is no especial difficulty in keeping the terms to their proper uses. We would, therefore, suggest as perhaps the first step toward a proper nomenclature, that *lux* be from now on used, in so far as is possible, as the working unit of illumination, and that when unqualified it shall mean just what Professor Blondel specified, and nothing else. We think that British and American engineers can be counted on quite generally to lay aside the foot-candle, and German engineers should be willing to help by writing H.L. when they are using the hefner as a unit. Incidentally, the general use of the lux would put a final end to the somewhat sophistical discussion regarding "foot-candle" and "candle-foot" with their respective plurals. This is not in the least a proposal for international action, which will come in due time from the proper sources, but an appeal to the common sense of technical writers in order to promote simplicity and exactness of statement.

U. S. Magnetic Tables and Charts for 1905.

The Department of Commerce and Labor has recently published, through the office of the Coast and Geodetic Survey, a fine set of magnetic tables and charts for the United States and adjoining countries, reduced to the year 1905. The work has been prepared under the supervision of Dr. L. A. Bauer. There have been over 3000 stations at which magnetic observations have been taken in arriving at the results published in this book. The results have been tabulated by States and countries, giving the latitude and longitude of each station, the declination, inclination and horizontal intensity, reduced to the year 1905. The angles of declination and inclination of the needle are tabulated to the nearest minute of arc. We are glad to see that the horizontal intensity is tabulated in c.g.s. units, so that the earth's horizontal magnetic force is read off directly in gilberts per centimeter, or the earth's magnetic flux density in gausses. An extra table is given for magnetic observations made at sea on specially equipped ships. These observations were made in the Atlantic Ocean, the Pacific Ocean and the Gulf of Mexico. Such tables are of particular interest to navigators.

It used to be supposed not long ago that the lines of equal magnetic declination made smooth, graceful curves on the map. That is, if we connect by a line all places on the map of North America where the magnetic needle points, say, 5 deg. east of the true meridian, or has an easterly declination of 5 deg., it used to be supposed that the line so drawn would be a smooth curve. In a similar manner, it used to be believed that ocean depths varied smoothly and gradually, so that ocean contour lines or marine charts used to be graceful curves. Now we know that, in both cases, the smoothness was the smoothness of ignorance. As more observations have been accumulated, it has come to light that in lines of equal magnetic declination, as in contour lines of ocean depths, there is a very erratic and zigzag progression. The agone, or line of zero declination—that is, the line connecting points in North America where the magnetic needle points geographically north—commences at the top of Lake Michigan, passes near to Dayton, Ohio, Winchester, Ky., Knoxville, Tenn., and Charleston, S. C., thence following the Bahamas to San Domingo. At all places in North America east of this line, the

needle deflects to the westward of the meridian, and at all places west of this line the needle deflects to the eastward of the meridian. The line itself, like the street in Damascus "which is called straight," wanders from side to side as the meandering brook. At Nova Scotia, in the east, the declination amounts to some 25 deg. W.; while at Vancouver in the west the declination reaches 25 deg. E. Consequently an observer traveling across the American continent, from Nova Scotia to Vancouver, would find the compass needle describing a total angle of 50 deg. with respect to his meridian.

Curiously enough, the agonic line of 1905 is not far from being a line of no annual change in declination, so that the agone is at present substantially at rest. As we travel east and west from the agone, the declination of the needle is found changing with time more and more. In New England the declination of the needle is increasing at the rate of about 1 deg. in 20 years. On the Pacific Coast the declination is increasing at the rate of about 1 deg. in 15 years. Consequently, where the needle in North America points westward of true north, it is tending slowly to point yet further westward; where it points east of true north, it is tending to point yet further eastward; while at places where it points nearly due north, there is but little change. As to what causes all these remarkable changes, recent inquiry tells us but little. Complexities have thickened with increasing observations thus far. Part of the change appears to be due to slow variations in the magnetization of the earth, and part to variations external to the earth's crust, possibly residing in the atmosphere. There is still much to be learned before explanation arrives on the scene. The rate of increase of knowledge has, however, grown rapidly in recent years, and it would not be surprising if generalization soon set in.

Wireless Telegraphy as a Business.

Bulletin 102 from the Bureau of the Census gives a merciless reckoning of the conditions of wireless telegraphy up to the end of 1907. It includes such data as were available from the six companies actually doing a commercial business at the time, and, while it is likely that the present situation is a trifle better, the figures are enough to show the necessity of earnest effort directed toward putting the work on a more conservative basis. To summarize the situation briefly, the companies are trying to carry liabilities aggregating on paper some $33,000,000 on gross receipts of $122,000, faced by expenses of nearly $170,000. On closer analysis, however, the case is not quite so bad as it looks, since more than $26,000,000 of the total stands for patents and such value as may attach to "good will" and other stuff that dreams are made of. The actual physical assets of the six companies were a little in excess of $400,000 at the date named, to which sum the earnings do not bear so absurd a proportion, although the operating expense still looms large. An analysis of the operating expense brings out the fact that the general expense as shown by the salary list is not excessive, amounting to less than $6,000 per company, and the bulk of the outgo is for legitimate wages and material account. The deficit for the year is clearly chargeable to lack of business rather than to excessive expenditures.

This is the hopeful feature of the situation. It means that while the whole wireless art is in that formative condition of exploitation that makes for large stock issues at all sorts of prices, it would not take any extraordinary increase of actual messages sent to show earnings quite big enough to cover expenses and up-keep, or even to pay some return upon the actual money paid for stock. In order to get earnings, however, an increase of the number of stations, particularly long-distance stations, must be made, and there has been a gratifying increase of these since the date of the Census report. At the date of the report the receipts for the year amounted to only about $1,000 per station in service. Three or four times this amount would not be an unreasonable expectation for well-chosen stations, without material increase of operating expense, so that, in spite of the deficit shown, the chance of converting it into a good profit is not remote, assuming careful management. Of course, the capitalization is fanciful and not to be taken seriously, but we see no reason why the business in general cannot be put on a reasonably profitable basis when it is reasonably well-handled. Every new and sensational industry has to go through a period of wild exploitation before it settles down, and the wireless business has merely been sowing its wild oats a little more flamboyantly than is usual. Of course, nobody can consider that the $26,000,000 patents and good-will item is much more than a joke, but, on the other hand, nobody seriously expects profits to be paid against that sort of thing. Of the capital stock some $5,600,000 was still in the treasury and should not come out except with the result of increasing earnings. So absurd as the whole financial statement looks, it is not going to imply that wireless is going to the dogs.

It does imply, however, that it is high time for the various wireless "systems" to settle their differences, stop fighting among themselves and get down to a permanent *modus vivendi,* if not actual complete consolidation. The possibilities of wireless working are as yet scarcely touched, and they will never be fairly opened so long as those who should do the work are wearing out their energies in internecine strife. There is a wireless business amounting certainly to a few million dollars a year awaiting a serious united effort to obtain it. Once the plants are established, the operating expenses should be far lower than in any ordinary telegraph system. In 1907 there were 29,000 ordinary telegraph offices in operation from which the receipts were some $45,000,000. The vast majority of these offices are in small towns and contribute only a trivial proportion of the total receipts. There is business enough to enable the wireless systems to establish a profitable showing at any time they are willing to come down off their high horses and get to work, and we hope and believe they ere long may. The secret of success lies in such united action as will establish commercial chains of stations in places that will furnish a paying traffic. Never mind about that imposing $33,000,000—the water will come out without much squeezing and leave something really coherent. The patent squabbles should be settled out of court by a board of adjudication, the stations standardized as far as may be, and suitable relations with the Government wireless interests established. Then get after regular commercial work, particularly the transatlantic and coastwise work, which promises the largest and most immediate profits. Wireless telegraphy is now all ready for this task, while it has not yet shown ability to compete in the general small work of telegraphic communications. But it is time to take potent remedies against the exploitation fever, which we trust has nearly had its run.

A Patent-Office Abuse.

As an illuminating illustration of the manner in which the U. S. Patent Office can be used to the detriment of the public and of the development of an industry, the following history of the Selden gasoline automobile patent is reprinted from the *Evening Post* of Sept. 17. The patent, which has recently been sustained by Judge Hough, but whose decision will be taken on appeal before a higher court, is essentially a "paper patent," which has not had the slightest influence on the art, but has rather acted to deter its development in this country. Were it not for the existence of this patent, most probably the United States and not France would have taken the leading part in the technical development of the gasoline motor-vehicle. With a "fundamental" patent covering any improvement that might be added to the art, inventors naturally have had no incentive to labors, the fruits of which would be confiscated; and the litigation which has attended the patent and the commercial combinations to which it has given rise, have still further handicapped originative gasoline motor-vehicle work in this country. Following is the extract from the *Evening Post:*

"In view of the interest aroused over the unexpected turn in this case, the story of Selden's adroitness in filing his claim to the now famous patent was recalled by men who have followed the litigation from the start. Selden was far-sighted enough to see the wonderful development of the horseless carriage of the future, and he realized at the same time that his patent rights would only last 17 years, a period which he knew would be far too short for him to reap any reward from his ideas. Selden believed that the horseless carriage of the future would take time to perfect, and he therefore went immediately about setting his patent ahead as far as possible, so that it would still be in force when the horseless carriages were in general use.

"George B. Selden was a patent attorney of Rochester when he filed an application on May 8, 1879, for a 'road engine' driven by a hydrocarbon motor, and he received his patent for the same on Nov. 5, 1895, a period of more than 16 years having elapsed before his rights of 17 years began, and also a period throughout which his patent was protected just as safely as if he already had letters on it.

"Selden, by his skilful manœuvring, virtually made his patent rights cover a period of almost 34 years, and as it turned out, it was in effect at the right time when the motor car was reaching its highest stage of development. Selden's patent, as a matter of fact, still has about three years more to run.

"When Selden applied for his first papers he knew, as a patent attorney, that under the law which was then in force (amended in 1897), an application for a patent could not be considered to have been abandoned if prosecuted within two years after the last official action. By complying with the letter of the law, Selden managed to delay the granting of this patent just 16½ years.

"An authority on patent procedure, in commenting on this case, said to-day:

"'The record of the case in the Patent Office shows that application was rejected on May 31, 1879, and that an amendment was filed on May 26, 1881, nearly two years later, but still good within the law. A second rejection on June 17, 1881, was followed on May 15, 1883, by another amendment, and a third rejection on May 26, 1883, was met by an amendment filed on May 18, 1885. An official letter sent to Mr. Selden on June 15, 1885, was not acted upon until June 13, 1887, only two days before the expiration of the two years of grace allowed by statute.

"'Another rejection on June 21, 1887, was answered by a letter dated April 13, 1889, and an amendment filed on June 10, 1889. Mr. Selden was required on June 14, 1889, to furnish "smooth copy" of the specifications prior to the issue of the final letters, but although the application was otherwise ready for issue, it was not until June 5, 1891, nine days before the statutory limit, that the substitute specifications were sent in.

"'An official letter of July 1, 1891, demanded a new oath prior to issue, but it was not until June 28, 1892, that Mr. Selden obeyed this order. The case was transferred to another examiner by whom some of the claims previously allowed were rejected on July 29, 1893. The next amendment was filed on April 1, 1895, and the patent finally granted on Nov. 5, 1895, just about the time when the horseless carriage, as it was first called, began to make its first appearance on the streets of the large cities.'"

As an indication of the character of the Selden patent, we reprint below the first claim, which Judge Hough in his opinion states is the principal claim in suit:

"The combination with a road locomotive, provided with suitable running gear, including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas engine of the compression type, comprises one or more power cylinders, a suitable liquid fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device, and a suitable carriage body adapted to the conveyance of persons or goods, substantially as described."

Convention of Car-Lighting Engineers.

The Association of Car Lighting Engineers will hold its second annual convention in the southeast corner room on the second floor of the new Hotel LaSalle, Chicago, on Oct. 4, 5, 6 and 7. This young association, consisting of steam-railroad men interested in electric car lighting, has been remarkably successful, and a large attendance is expected. The program includes papers on the "Application of Electricity to Railroad Shops," "Electrification of Steam Railroads" and "Storage Batteries as Applied to Train Lighting." In addition there will be the president's address, reports of standing committees, including the committee on standards, and ample opportunity for discussion. Among the subjects to be brought before the meeting is a change of name to "Association of Railway Electrical Engineers." The work of most of the electrical engineers of railroads extends beyond car lighting, and the proposed name will more nearly characterize the membership of the body. There will be a banquet on the evening of Oct. 6. Mr. A. J. Farrelly, electrical engineer of the Chicago & Northwestern, Chicago, is president of the association, and Mr. G. B. Colegrove, chief electrician of the Illinois Central, Chicago, is secretary. The list of names of committees, with their respective chairmen, is as follows:

Standards, Mr. L. V. Cartwright, electrical engineer, Lehigh Valley, South Bethlehem, Pa.—Data and Information, Mr. W. A. Hopkins, electrical engineer, Wabash, Decatur, Ill.—Publicity, Mr. E. W. Jansen, chief electrician of telegraph department, Illinois Central, Chicago.—Subjects for Discussion, Mr. E. M. Cutting, engineer of car lighting, heating and ventilating, Southern Pacific, West Oakland, Cal.—Improvements, Mr. J. H. Shaw, electrical engineer, Canadian Pacific, Westmount, Canada.—Lamps, Mr. H. C. Meloy, chief electrician, Lake Shore & Michigan Southern, Cleveland.—Auditing, Mr. J. A. Andreucetti, assistant to electrical engineer, Chicago & Northwestern, Chicago.

Convention of Illuminating Engineering Society.

Following is the final program of papers of the annual convention of the Illuminating Engineering Society to be held in New York City Monday to Wednesday of next week. Among the social features will be an automobile tour of the city on Wednesday for the visiting ladies, in 20 seven-seated touring cars. In the evening of that day there will be a reception in the Machinery Club in the Hudson Terminal Buildings, from which an excellent view may be obtained of parts of the spectacular Hudson-Fulton illumination.

The meeting on Monday morning will be opened by an address of welcome by Mr. T. C. Martin and response by Dr. Louis Bell. The address of President W. H. Gartley will follow, after which reports will be presented on nomenclature and

standards, on unit of light and on photometric units. The papers contributed will be presented on Monday afternoon and the mornings and afternoons of Tuesday and Wednesday. On Tuesday evening Dr. C. P. Steinmetz will deliver a lecture on "The Physiological Effects of Radiation." Following is a complete list of the papers:

The Ethics of Illuminating Engineering, by Mr. E. L. Elliott.—The Work of Dr. Carl Auer von Welsbach in the Field of Artificial Illumination, by Mr. Geo. S. Barrows.—The Progress of Illuminating Engineering in Europe, by Mr. W. T. Owens.—Diffusing Mediums, by Mr. A. J. Marshall.—Illuminating Engineering from the Educational Standpoint, by Mr. F. K. Richtmyer.—Photometrical Laboratory of the United Gas Improvement Company, by Mr. Chas. O. Bond.—Physical Laboratory of the National Electric Lamp Association, by Dr. Edw. P. Hyde.—Notes on Chemical Luminescence of Rare Earths, by Dr. Angelo Simonini.—The Light of the Firefly, by Drs. H. E. Ives and W. W. Coblentz.—Allowable Amplitudes and Frequencies of Voltage Fluctuations in Incandescent Lamp Work, by Mr. H. E. Ives.—The Principles of Shades and Reflectors, by Dr. Louis Bell.—Standard Relations of Light Distribution, by Mr. A. J. Sweet.—The Problem of Heterchromatic Photometry, by Mr. Preston S. Millar.—Some Results Obtained Through Illuminometry, by Mr. Norman Macbeth.—Factory Lighting, by Mr. L. B. Marks.—Operating Efficiencies of Some Commercial Installations of Lighting Systems, by Mr. A. L. Eustice.—Tests of Moore Tube Installations—New York Post Office, by Dr. E. P. Hyde and Mr. J. E. Woodwell.—Tests of a Moore Tube, by Dr. C. H. Sharp and Mr. P. S. Millar.

Educational Plans of the Baltimore N. E. L. A. Section.

The Baltimore Section of the National Electric Light Association have arranged through the courtesy of the management of the Consolidated Gas, Electric Light & Power Company, of Baltimore, for a course of experimental lectures on electrical engineering to be given to its members the coming winter. The lectures will be given on Tuesdays, commencing Oct. 5, and will extend for 20 successive weeks under the direction of Prof. Sydney W. Ashe. The lecture course will be similar to the successful first season's courses given to the New York, Brooklyn and Boston Edison companies in past years. While the lectures will be given primarily to members of the local section, arrangements will be made to accommodate non-members who are sufficiently interested. A small fee will be charged to limit the attendance to those interested and to make the course as far as possible self-supporting.

Chicago Street-Railway Labor Dispute Settled.

By a decisive vote the unions of street railway men in Chicago agreed on Sept. 16 to accept the settlement in the matter of the wage dispute proposed by President Mahon, of the International Union, and accepted by President Roach, of the Chicago Railways Company, and President Mitten, of the Chicago City Railway Company. Mr. Mahon recommended that the new proposition be accepted rather than to submit the dispute to an unpromising arbitration. There was considerable opposition to the proposal by the more radical union men, but the vote was very largely in favor of acceptance. The new wage scale will result in a substantial increase to all employees and will provide a graded scale for men taken on after Aug. 1, 1909. The contract between the companies and men will run for three years from that date. The plan provides that men who have been two or more years in the service shall be paid 28 cents an hour for the first year of the agreement, 29 cents for the second year and 30 cents for the third year. Similarly, men now employed, but who have not completed two years of service will be paid on the same ascending scale after the expiration of two years from the date of entering the service of the company. New men employed subsequent to Aug. 1, 1909, are to receive 23 cents an hour the first six months, 25 cents an hour for the second six months, 26 cents an hour for the second year and so on, increasing a cent an hour until they receive 30 cents an hour in the sixth year of service. The contract also contains provisions for increased wages for barn men and shop men. It is asserted that the increase of wages will amount to $1,800,000 for both companies during the contract period of three years. The first offer made by the companies and rejected by the men was based on an increase of about $1,000,000 over the present payroll for a contract period of five years. The controversy has lasted several months, and on two or three occasions it has appeared that a strike was inevitable.

Water-Power Development at Oregon, Ill.

Work is progressing on the wheel pits for the new water-power plant of the Oregon Power Company on the Rock River at Oregon, Ill., which has been previously mentioned in these columns. While the Rock River is a stream of very variable flow, it is calculated that with a reasonable steam auxiliary—say 50 per cent—a development of 4000 hp may be had the year around at Oregon. A dam 975 ft. long has been built, and the company will probably erect a deflection dam also. Three 66-in. Leffel turbine water-wheels have been ordered, and they will be placed in line on one shaft and drive a 600-kw, General Electric, 2300-volt, 60-cycle, three-phase generator. At one end of this shaft, connected by a clutch, will be a Cluse four-valve engine serving as the steam reserve for this unit. A clutch will also be placed in the shaft between the water-wheels and the generator, of course, so that the electrical unit may be driven by either source of power. The Oregon Power Company will supply electricity to a number of nearby towns and villages. Nearly 100 miles of transmission lines will be built ultimately in various directions, 35 miles being now in existence. The voltage of transmission will be 13,200, and there will be substations at Amboy, Franklin Grove, Sublette, Lee Center and Shaw's. Kuhlman transformers are used. Mr. Frank F. Fowle, of Chicago, consulting engineer, worked out the hydraulic details for this plant.

Proposed Unification of Railroad Terminal Facilities in Chicago.

Mr. F. A. Delano, president of the Wabash Railroad, was the speaker at the meeting of the Electric Club in Chicago on Sept. 15. His subject was, "A Plan for a New Union Passenger Railway Terminal for Chicago." Mr. Delano originated the proposal for a union passenger terminal in Chicago, or at least a clustering together of such terminals, five years ago, and he has given much attention to the subject since then. He was greeted at the Electric Club by an audience of over 100, and he explained to the gentlemen present that his interest in the topic was rather that of a citizen of Chicago than of a railroad president.

The rapid growth and interlacing of the 26 railroads entering Chicago has resulted in a confused condition of affairs. Of these railroads all except two enter the city at or south of Sixteenth Street. It would, therefore, seem feasible to construct a series of terminal units at some point just south of the "downtown" business district, and Mr. Delano suggests Twelfth Street as such a location. He recommends a series of terminal station units, the passenger traffic to be handled on one level and freight cars on a lower level, or possibly on two lower levels, making a three-decked construction. This arrangement would greatly facilitate the interchange of both passengers and freight. There are six main terminal stations in Chicago now, including the Northwestern terminal in course of erection at an expense of $20,000,000. The Illinois Central terminal is already placed on Michigan Avenue, at Twelfth Street, and

need not be disturbed. Perhaps the other four terminals could be built on Twelfth Street, side by side, and possibly the railroads interested would be willing to spend $20,000,000 on each.

The intramural transportation facilities between the existing terminals are unsatisfactory and the transfer of passengers, baggage and freight would be greatly simplified if the stations were placed as suggested. The speaker would be glad to see engineers study the subject and he presents the plan suggested merely for mature consideration and not as necessarily the only solution to the problem. A further possibility is that the existing railroad property north of Twelfth Street be used for warehouse purposes, connected with the terminals by elevated or underground railroads.

The matter of electrification of the railroad terminals was brought up in the brief discussion following the address, and Mr. Delano said that the details of the plan he suggests could be carried out more readily with electrical operation than with steam operation of trains. This would be particularly true in the case of the two-deck or three-deck track construction. Any tendency to the electrification of railroad terminals would help the plan suggested. If such electrification is found to pay in a city like New York, it may be expected to do so in a city like Chicago.

Joint Convention of Northwest Electric Light and Power Association and Seattle Section of A. I. E. E.

The second annual convention of the Northwest Electric Light and Power Association was held in connection with the Seattle Section of the A. I. E. E. in the Fine Arts Building at the Alaska-Yukon-Pacific Fair in Seattle, Sept. 7 to 9. There were present delegates representing approximately 85 per cent of the central stations operating in Washington, Oregon and Idaho, together with practically the entire Seattle section of the A. I. E. E., and a number of guests, including Messrs. W. Natori, secretary of the Tokio Electric Light Company; Ralph W. Pope, secretary, A. I. E. E.; Charles F. Scott, past-president, A. I. E. E.; P. M. Lincoln, of the Westinghouse Company; Frank H. Gale, of the General Electric Company; A. W. Ballard, Los Angeles branch General Electric Company; Sir James Ward, Dublin, Ireland; J. R. Geary, of the Yokohama branch, General Electric Company.

The Northwest Electric Light and Power Association was formed a year ago by a few companies at a meeting held in Seattle, and since that time has grown until at this meeting delegates were present, as stated above, from about 85 per cent of the central stations doing business in Washington, Oregon and Idaho, the States embraced in the association. The body is an association of central stations formed for the purpose of bettering the service and business by closer relationship with each other, and for the mutual exchange of ideas and information. It is modeled after the National Electric Light Association and with the same classification of members. A complete file of forms from all the member companies is kept by the secretary, including accounting, operating, legal, etc., which records are at the service of the members upon request, thereby enabling them to learn and, if desired, adopt for their own use the best methods of other companies. The conventions are more in the line of "experience meetings," where questions as to operation and business methods are freely discussed and personal experiences exchanged.

Each member and guest was supplied with a coupon book containing coupons for a reception and dance on Tuesday evening, a pass for sight-seeing trolley cars, a steamer pass for a trip around Lake Washington, a steamer pass for a Sound trip and a pass for a vaudeville entertainment.

After the usual addresses of welcome and the proper responses, Mr. John Harisberger, president of the Seattle Section, A. I. E. E., took the chair to preside over the technical session, which was entirely in charge of the members of the A. I. E. E. Mr. Ralph W. Pope delivered an address upon the administration of the Institute, dwelling with particular emphasis upon its growth in the West, and congratulating the Seattle section upon its enterprise and the success of the present convention. Mr. Pope visited the convention primarily to investigate the policy of joint sessions of the A. I. E. E. with other organizations, and before the close of the meeting expressed himself as more than pleased with the results accomplished.

Mr. Pope was followed by Mr. C. E. Fleager, of the Pacific Telegraph & Telephone Company, who read a paper upon "Modern Central Telephone Stations."

Mr. Paul M. Lincoln then presented a paper on "Protection of Electrical Equipment," which provoked the fullest discussion of the first day's session, with special reference to his theory of an electric "surge."

Mr. Lincoln in opening his paper illustrated the principle of electrical surges by a hydraulic analogue consisting of pipes perfectly flexible made of india rubber. In discussing the protection of high-tension systems by grounding the neutral, it is stated that this may be done either by connecting solidly to the ground or by putting in a greater or less resistance between the neutral point and the ground. The question of a grounded neutral may be considered, first, from the viewpoint of protection to the equipment, and, second, from protection to the service. As to the protection of apparatus, the advantage in solidly grounding the neutral is that the normal voltage to ground can under no conditions rise to more than 58 per cent of the normal voltage between conductors, which is of the utmost importance when considering insulation strengths to ground of the various apparatus involved. On the other hand, the disadvantage is that every ground which occurs develops immediately into a short-circuit, which in turn causes severe mechanical stresses to be set up in the windings of the transformers and the generating apparatus. It is the opinion of Mr. Lincoln, so far as the protection of apparatus is concerned, that the advantages of the grounded neutral very much outweigh the disadvantages. As to protection of the service, the development of the short-circuit noted above will in high-tension transmission cause the resulting arc to continue until the power to that particular section of the line is cut off; consequently, many engineers prefer to ground through a resistance instead of connecting solidly to ground. A satisfactory type of resistance for this service is difficult to secure; cement columns have been used for the purpose, but Mr. Lincoln was of the opinion that a metallic form of resistance is the best. Following is a recapitulation of the means for protection against the effects of electrical surges:

First, the overhead guard wire which keeps down the quantity of electricity which a given lightning discharge is capable of superposing upon a transmission line. In practice it has shown itself to be a valuable device in many instances of high-tension transmission.

Second, lightning arresters of a type which will allow a free discharge of static electricity from the transmission line whenever the voltage of the charge exceeds normal by a certain predeterminable amount. With a proper equipment of such lightning arrester the size of the surge which may enter electrical apparatus is limited.

Third, the grounded neutral. Grounding solidly prevents the potential of a neutral point of a transmission line from departing from ground potential, which in turn prevents the normal operation of this line from causing more than about 58 per cent of line voltage appearing between any conductor and ground. Grounding through a resistance has the same effect to an extent depending upon the amount of resistance used.

Fourth, insulating between turns. It is highly essential to insulate electrical apparatus between turns so that it will stand a momentary potential many times the normal. This consideration shows the enormous advantage of using transformers upon a transmission line in distinction to connecting generators direct. The amount of insulation that can be used between turns in a generator is limited by the necessity of placing the winding in relatively small slots. In a transformer this consideration does not operate to nearly so great a degree owing to the fact

that the space occupied by the windings is, so to speak, in one piece instead of being divided up into a large multiplicity of small slots. Moreover, the presence of oil in the case of the transformer gives it an advantage which the generator cannot have under any conditions.

The afternoon session was devoted to the following papers: "Electrical Illumination from the Central-Station Standpoint," by Mr. W. M. Hamilton, Portland Railway, Light & Power Company; "High-Efficiency Lamps," by Mr. E. W. Sherwood, General Electric Company; "The Trend in Electrical Development," by Mr. Charles F. Scott, Westinghouse Electric & Manufacturing Company.

These three papers all bore out very well the central theme or purpose of the convention, to wit, the increase of the load factor, giving to the central station an additional revenue without raising of rates or the addition of more generating apparatus. Mr. Sherwood's paper was well illustrated by lantern views.

The session of Wednesday was presided over by Mr. Arthur Gunn, president of the Northwest Electric Light and Power Association, and was devoted to commercial papers. The report of the rate committee by its chairman, Mr. M. C. Osborne, was of special interest to the members of the convention and led to a general discussion. While no attempt is being made to fix rates, at the same time a common basis for arriving at a rate schedule is the object and purpose of the rate committee. The readiness-to-serve charge received special attention, and Mr. Osborne gave an exceedingly comprehensive schedule, showing the income to the central station per kw-year worked out with reference to the connected load and the load factor of the consumer. Mr. Frank Dabney, chairman of the committee on uniform accounting, strongly advocated the system proposed by the National Electric Light Association with such modifications as necessary to fit the needs of the small companies.

Mr. J. H. Whitaker, of the Seattle-Tacoma Power Company, then presented a paper upon methods of handling complaints, giving his personal experiences of many years in the central-station business.

Mr. Whitaker urged promptness in giving attention to every complaint, and making a record of each case, setting forth all details and final disposition. He urged that the expression, "I complained, but got no satisfaction," should not gain a foothold in one's territory. A great aid in minimizing complaints is to instruct customers, so far as possible, how to read meters and to compute the bills. All meters should be inspected at least once a year, or in cases of large installations, every six months, and customers should be advised of a test and informed of the result. In taking care of what might be called mechanical troubles, such as are incident to arc and Nernst lamps, the blowing of fuses, etc., a printed form will be found of value. Such a form should include the time a call was received, when attended to and by whom, nature of the trouble and its remedy, and, above all, the signature of the customer showing that his complaint had been cared for.

A paper upon "Electrical Appliances and Their Influence on Load Factor," by Mr. A. G. Jones, of the General Electric Company, followed. This paper aroused vigorous discussion, in which Mr. F. H. Gale, of the General Electric Company, took an active part. The delegates were very desirous of obtaining definite figures as to the cost to the consumer of electricity in comparison to gas at $1 per 1000 cu. ft. or coal at $6 per ton for the purpose of cooking and heating. The trend of the discussion seemed to be that while the electric flatiron, toaster, chafing dish and other small appliances were beneficial to the central station, the larger cooking devices were a good thing to let alone.

The next paper, entitled "The Electric Vehicle as a Correction of Poor Load Factor," was presented by Mr. R. V. Daggett, president of the Pacific Coast Electric Vehicle Association, and was well received by the delegates, as indicated by the numerous questions propounded, which showed a live interest in the topic treated.

Mr. Daggett said that while the gasoline automobile has had a phenomenal growth and has come to stay, the electric vehicle is better adapted for use in cities, and especially in congested districts. It is less noisy, requires fewer repairs and has a lower cost of maintenance. Repairs on the battery may be made without putting the vehicle out of service, which is not so in the case of repairs to the machinery of a gasoline machine. The electric vehicle is most easily operated, requiring less skill and knowledge of mechanics. The author estimated that there are fully 10,000 electric vehicles in use in this country. Southern California and Seattle show the greatest development along the coast. Los Angeles has in use about 575 electric vehicles. The charging rate in Southern California varies from 2 cents to 6 cents per kw-hour, according to the amount of current and whether the supply is for a private or a public garage. The average income per month from an electric vehicle from private garages is about $5.50, and from public garages the total varies from $50 to $200 per month. If it is estimated that while the income per vehicle is only $3 per month, the total income per year for 575 vehicles would be $19,500. In Los Angeles one company operates about 12 electric trucks, but should all of the trucking be done with electric vehicles it can be readily appreciated what an enormous increase in power consumption would result. In Seattle there are about 100 electric vehicles, including both those used for pleasure and commercial purposes. Seattle has steep grades, but experience has shown that with proper design the electrical vehicle is as well adapted to high hills as any form of automobile.

Wednesday afternoon and Thursday morning were devoted to the executive business of the association. The report of the secretary showed that in the single year's growth the body had drawn to its membership rolls practically 90 per cent of all the companies operating in the territory embraced, while the treasurer reported a balance for the fiscal year of $1,015.88.

The president, in his address, thanked the members for their support during the year, and congratulated the member companies for their willingness to aid each other in the matter of forms, information and data regardless of the keen commercial rivalry existing between some of them. He also presented an able paper upon "Employers' Liability and Employees' Indemnity," in which he urged upon the members the importance both from the commercial and humanitarian standpoint of the employer and employee getting together upon common ground in the settlement of cases of personal injuries without the intervention of lawyers and courts. He dwelt upon the German and English method, and recommended that the employer surrender his defenses in law, namely, the doctrines of assumed risk, contributory negligence and negligence of a fellow servant, provided the employee would in turn consent to a schedule to be paid for injuries which would be fair to both. Under this plan every injured employee would receive compensation, and all the money now paid by the employer and the employee for lawyers and litigation would go direct to the employee.

The election of officers resulted as follows: President, Mr. Arthur Gunn, Wenatchee, Wash.; vice-president for Oregon, Mr. H. V. Gates, Hepner, Ore.; vice-president for Idaho, Mr. D. C. McKissick. Vacancies on executive committee: For three-year term, Mr. O. B. Caldwell, Portland, Ore.; for one-year term, Mr. C. H. McNary, Clarkston, Wash.; secretary-treasurer, Norwood W. Brockett, Seattle, Wash.

The entertainment features of the program were in charge of Mr. W. E. Best and were exceedingly well carried out. Every possible courtesy was extended to the delegates and their families, and a rising vote of thanks was extended by the convention to Mr. Best and his assistants, Mr. Winter and Mr. Kollock.

Annual Meeting of the Vermont Electrical Association.

The annual meeting of the Vermont Electrical Association was held at the Van Ness House, Burlington, Vt., on Sept. 15 and 16, with an excellent attendance, reaching about 100. The

association now includes 17 of the operating light and power companies in the State and its meetings are rapidly developing in interest and importance, as evidenced, in one way, by the influx of supply men every year.

The meeting was called to order on Wednesday afternoon, Sept. 15, by President F. H. Parker, of the Burlington Light & Power Company. It had been intended to precede this by a business meeting in the morning, but this plan was abandoned on account of a parade of the U. S. Cavalry and of the local fire brigade. The afternoon meeting was opened by an excellent address from Mr. V. R. Lansingh, of New York, on "The Need of Educational Work in Illumination." He treated his subject under two heads—store lighting and house lighting. With regard to the latter division he argued strongly for the tungsten lamp as emphatically the one best suited to household purposes. To-day in most household lighting the lamps were often black or of high wattage, and were generally placed in wrong positions or at a wrong angle. Very often the only means of turning them on or off was an awkward key socket, and there was too much use of inefficient glassware aiming at artistic colored effects. The placing of the lamps in the kitchen, he insisted, was, if anything, of more importance than their location in the dining-room. He then went into details as to the proper lighting of every part of the house, and claimed that it was the duty of the central station to educate its solicitors and the public in dealing with these matters. As to porch lighting, he noted that less than 1 per cent of porch lamps were used, probably because they were of too high candle-power; but the suggestion was offered that a good deal of effective street lighting could be done from porches. All the rooms of the house were then taken up in turn, and practical hints were given as to the proper papers and coloring for ceilings and walls. Mr. Lansingh then took up store lighting, in regard to windows and interiors. The former was lighting to show off goods or attract attention, and was sometimes a combination of the two. The points as to interior lighting were also dealt with.

Mr. Walter Jones then gave a very interesting account of his experiences in New Haven, Conn., in developing a campaign of education in illumination, where a vacant store was taken for free lecturing purposes. The result of the first effort was 72 applications for advice, from business men, and then the next effort brought 200 applications, making the campaign a very successful one in its additions to the central-station load in improved lighting.

Mr. C. H. Scott, of Boston, presented an interesting paper on "The Extension of Power Business for Central Stations." In was an incisive analysis of power conditions in the State, the *Central Station Directory* showing a population of 185,000, or 51 per cent of the total population of the State, served by 45 plants and a horse-power per capita of 15. He suggested that the association should ascertain to what exact extent electrical energy had been utilized in farm and dairy, as well as in other industries. He took up also the items of lumbering and stone quarrying, and pointed out the growing importance of the Vermont textile mills as a market for energy. He emphasized the idea that the extension of the day load is to be sought particularly among small users, especially in the homes. Mr. Scott made a number of pertinent suggestions as to general publicity methods and urged strongly the use of newspaper advertising.

Mr. T. C. Martin addressed the association as to the desirability of becoming affiliated with the National Electric Light Association, preferably as part of the existing New England section, though not of necessity giving up the present organization. He alluded to the interesting fact that the National Association owed so large a part of its remarkable success to the extraordinary ability of a Vermont woman, who had devoted 20 strenuous years of her life to its upbuilding, and whose work gave her high rank among the notables of her sex in this country. He felt that Vermont companies might well emulate her noble enthusiasm in regard to the national body. Of the 17 companies in the Vermont Association, 14 were already members in the National organization, so that it would be very easy to "line up" as a State. Mr. Martin also described the work of the "N. E. L. A." in its relation to public questions, such as insurance, conservation, freight, tariff, corporation taxes, and public-service commissions, and gave an outline of the association work in its annual convention, its transactions in three large volumes this year, its bulletins, its solicitors' handbook, its "Question Box" and other respects in which it served as a clearing house for information relative to an industry that touched modern American life at all its vital points. All this data and work were at the command of State organizations cooperating with the National body in an intelligent, unselfish but protective movement for the good of all.

During the day the members and visitors were generously entertained by the local company and its staff, both at the office headquarters and at the Ethan Allen Club. The company has a beautiful stone and brick building of its own put up for the purpose, complete in all departments, and in keeping with the tone and air of a city where, with a population of 20,000, one of the local banks has 30,000 depositors and deposits of $11,000,000. The Burlington Light & Power Company has about 1700 electric customers and 3000 for gas.

At the evening session, Mr. T. C. Martin read a paper on "The Unevenness of Electrical Development," in which the argument was made that the central-station service was uneven and unequal that did not include everybody within its reach. In advocating the importance of the diversity factor and of the heterogeneity of patronage he pointed out that while in 1902 the average income from a public arc lamp was $83.20, it had fallen in 1907 to $69.57. The yield of a commercial arc in 1902 was $48.88, while in 1907 it was $39.99. In incandescent lighting, in the same period, public lamps fell off from $6.06 to $3.80 and commercial lamps from $2.40 to $1.98. Mr. Martin then discussed various sources of income, and enlarged on the importance of power-plant records and of checks on supplies and materials as one way of preventing the curious unevenness of development and of financial yield in central-station work.

Mr. F. W. Willcox then followed with an admirable paper on "Results from Tungsten Lamps" with reference to central-station service during the past year, and with this pregnant premise: "It is the history of all great inventions designed to save valuable time and labor that they have been criticised and condemned because they threatened ancient industries or 'threw people out of work.' The succeeding history of such inventions, however, shows that labor has invariably found more profitable employment, and that conditions have rapidly adjusted themselves so that the benefits of successful ingenuity can be fully realized." The paper was a brilliant expansion of this theme, and showed how the tungsten lamp by its new economic values had revolutionized favorably the conditions of illumination, from the central-station standpoint. Mr. Willcox gave a table showing sales by his company of 1,579,593 tungsten lamps in the last six months, of which 35 per cent was in 25-watt lamps, and 17 per cent in the 40-watt, "small-bulb" lamp, which is rapidly coming to the front as more durable than the 25 unit and a better competitor with the Welsbach. "A noticeable fact about the sizes of lamps is that the lamp which is most popular in any given city is the one which is most aggressively pushed in that city." It also appeared that where a central-station company handled the lamp the units sold were uniformly larger than when they were sold by a local supply company. The paper entered also into questions of maintenance, and cited the Rochester (N. Y.) company which makes a small charge for four inspections a month, cleaning the lamps and the glassware. Details were also given as to features of introduction, charging for service, etc., and the effect on revenue.

The following officers were elected: President, J. E. Davidson, Montpelier; first vice-president, C. E. Parker, Vergennes; second vice-president, Frank Barney, Jr., Springfield; secretary and treasurer, A. B. Marsden, Manchester; executive committee: F. J. Royce, Bellows Falls; C. C. Wells, Middlebury;

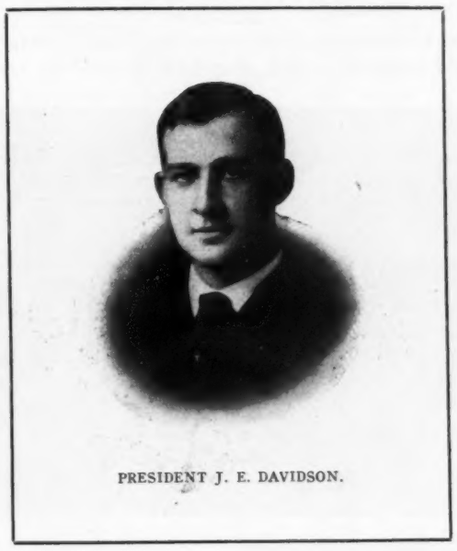
G. S. Haley, Rutland; W. H. Vorce, St. Albans; W. M. Hughes, Bristol.

On Thursday the members and guests made an excursion on the *Ticonderoga* to Bluff Point, across Lake Champlain, where luncheon was served, the boat returning at 3:15 p. m.

At an adjourned meeting of the association, held on the boat on Thursday afternoon returning from Bluff Point, the association, by formal resolution, decided to become affiliated with the New England Section of the National Electric Light Association.

MR. J. E. DAVIDSON.

Mr. James Edward Davidson, the new president of the Vermont Electrical Association, was born at Flint, Mich., Nov. 10, 1879. He is the son of Mr. W. F. Davidson, of Port Huron, a pioneer in central-station installation and operation in the State of Michigan, in which State he represented the Thomson-Houston Company for some years as agent. After passing through the public and high schools of Port Huron, Mr. Davidson took a course at the Detroit Business University. As a boy his vacations were spent in the power house at Port Huron, and after leaving school he went at once to work in that plant, of which he became superintendent in 1899. During Mr. Davidson's superintendency a 1500-kw Curtis turbo-generator was installed, this being the first steam turbine of this make put into commercial operation. In 1902 he was appointed city electrical inspector of Port Huron, a position which he held until his removal to the East. In the spring of 1905 a syndicate of Port Huron and New York capitalists purchased the plant of the Consolidated Lighting Company, of Montpelier, Vt., and invited Mr. Davidson to take the management of the business. Upon his acceptance he was made a member of the board of directors, secretary of the company and general manager of the plant. He is now president of both the present underlying properties, each capitalized at $1,000,000. The plant includes a water-power station at Bolton Falls and a steam plant at Montpelier. These stations supply lighting and power to Montpelier, Barre, Waterbury and surrounding towns, and power is also supplied to the Montpelier & Barre Traction Company. In Barre and vicinity are some of the largest quarries and finishing sheds in the United States, and the Consolidated plant furnishes a large amount of electrical energy for quarrying and manufacturing granite. Mr. Davidson is an associate member of the American Institute of Electrical Engineers, and was secretary and treasurer of the Michigan Electric Association up to the time he left Port Huron. He has taken an active part in the creation of the New England Section of the National Electric Light Associaion, and is altogether a typical man of "light and leading," and an ideal representative of the progressive younger element in the art. Besides being president of the Vermont Association, he is vice-president of the New England Section, N. E. L. A.; member of the Illuminating Engineering Society and member of the Wireless Institute. He has been a frequent contributor of papers and articles.



PRESIDENT J. E. DAVIDSON.

Public Service Commission Hearing on Meter-Test Reports.

The Public Service Commission of the First District held hearings on Aug. 30 and Sept. 13 at 154 Nassau Street, New York, in the matter of standard forms of reports on tests of electric meters; the substance of the order appeared in our Aug. 26 issue. All of the electric light companies under the jurisdiction of the commission were represented at the hearings, and Mr. J. W. Lieb, Jr., of the New York Edison Company, embodied in his remarks the general sentiment of the various companies relative to the proposed order. Objection was made to the determination of the ratio of transformers used in connection with instruments on consumers' premises, where it was stated a proper test is impossible. It was also suggested that instead of annual laboratory tests of each transformer, periodic tests be made every five years, since there is little tendency to variation in present ratio transformers. Mr. Lieb stated that if indicating wattmeters are excluded from alternating-current meter tests it would make it obligatory to use only rotating standards, which are not available in the capacities required to test the larger installations. It was pointed out that for many tests indicating wattmeters are the only available and satisfactory instruments. With reference to the order of the commission calling for tests at one-tenth, normal and full rating of meter, it was suggested that inasmuch as it is not always practicable to pick out exactly a 10 per cent or full load, the word approximately be used, or at the nearest load obtainable. The classification given by the commission in percentage of installation to be used in determining normal load should, it was pointed out, be selected so that the percentages will be general averages, which, once fixed, should be adhered to, leaving nothing to the judgment of the person who makes the tests. All companies expressed the desirability of having two classifications in reporting the results of non-complaint meter tests; they favored only two tests in all: one, called periodic tests, which would also include tests made at the instigation of the company itself, and the other designated complaint tests, which would include only those tests ordered on the complaint of a consumer. The advisability of making public the details as to efficiency, etc., of various makes and type of instruments was questioned as detrimental to manufacturers.

Massachusetts Commission News.

The full bench of the Supreme Judicial Court of Massachusetts has dismissed the petition of Edmund Codman and others for an injunction to restrain the Boston Transit Commission from building a tunnel from Cambridge under a part of Boston Common to the vicinity of the present Park Street station of the Tremont Street subway. The starting of this work, which is the easterly terminus of the subway now under construction to connect Boston with the Harvard Square district of Cambridge, has been delayed several months by the opposition which developed in certain quarters to the construction of the tunnel under the Common. The commission has lost no time in signing the contract for this section of the subway since the unanimous decision of the court was handed down, and it is now expected that this important work will proceed steadily toward completion. The Boston Elevated Railway Company is building the portion of the subway that lies within the city of Cambridge, and active excavation is in progress at several centers along the route. The Railroad Commission has given its final approval to the plans for the stations, and the rest of the work appears to be largely a matter of engineering. It is noteworthy that the Supreme Court recognized the public importance of the project and refused to

permit further delay sought by the opponents of the Park Street terminus.

The Massachusetts Railroad Commission has approved the proposed changes of the Boston Elevated Railway Company at its stations at Dudley Street, Dover Street, and the South Station, to adapt the service at these points to the running of eight-car trains. A hearing was given by the board Sept. 13 on the petition of Councilman O'Bryan, of Boston, asking for an investigation of the transportation facilities at the Dover Street elevated station in Boston. Vice-President Sergeant presented conclusive figures showing that the company maintains an ample service through this portion of the system, which is one of the busiest points outside the immediate downtown commercial center of Boston, upward of 2500 cars per day passing the station in question. On the same day a hearing was given upon the petition of residents of Lynn asking that the fare on the Lynn & Nahant Street Railway be reduced from 8 cents to 5 cents. Although the petition was signed by a large number of persons no one appeared to press the matter before the board, in relation to the fare reduction asked in general relation to the railway, or in the matter of increased service during the winter months.

The Massachusetts Gas and Electric Light Commission postponed until the early part of October the hearing assigned for the petition asking for a rate reduction in Leominster, which was set for Sept. 16. Several hearings on gas matters are assigned for the latter part of the present month.

New York Public Service Commission News.

At last a trolley car has been run across the new $20,000,000 Queensboro Bridge. This was accomplished last week by the Board of Estimate authorizing the bridge commissioner to operate a temporary line with rented equipment. The consent of the Public Service Commission was not asked nor needed. The Board of Estimate also granted a franchise to the New York & Queens County Railroad Company to operate a line across the bridge, but this will have to be approved by the commission and may be turned down. Already the commission has refused to sanction the franchise for the South Shore Traction Company which was granted by the Board of Estimate, and, last week, the commission refused to give a franchise to the Third Avenue Bridge Company—the company organized by Receiver Whitridge, of the Third Avenue Railroad Company, for bridge service. The commission disapproved of the form of the South Shore and Third Avenue franchises.

It was announced last week that the Public Service Commission of the First District had prepared plans for a new subway route starting at the Battery and running up the west side under Hudson Street and Eighth Avenue to Fifty-ninth Street, under that street to the East River over the Queensboro Bridge to various sections of Queens Borough.

The commission sent a request to the Board of Estimate and Apportionment for an appropriation of $150,000 additional to pay for drawing and printing plans and specifications for new subway lines. The board made an allowance of $100,000.

The commission has appealed to the Attorney-General of the State for instructions and advice as to how to proceed to compel the removal of the tracks of the unused car lines from the streets of New York. There are 20.22 miles of this track involving 13 separate companies.

The Public Service Commission, Second District, has authorized the Cataract Power & Conduit Company, of Buffalo, to issue $149,000 5 per cent gold bonds, payable in 1927, to be sold at not less than 95. The proceeds are to be used for the acquisition of property and the extension and improvement of the plant of this corporation. The commission has also authorized the Cataract Power & Conduit Company to issue $4,000 in 5 per cent gold bonds to be sold at not less than 95, the proceeds to be used in paying indebtedness incurred in acquiring property and improving its plant and distributing system.

The Pawling Electric Light, Heat & Power Company has been authorized to begin construction of its proposed plant and exercise rights and privileges conferred by the village of Pawling, Dutchess County. The commission has also authorized the Pawling Electric Light, Heat & Power Company to issue its capital stock to the amount of 800 shares at the par value of $25 each, the proceeds to be used for the acquisition of its site and construction of its plant and generating system.

Electric Freight Locomotive for the New Haven Railroad.

In the accompanying illustrations are shown outline views of a freight locomotive being erected by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company for the New York, New Haven & Hartford Railroad. It differs from the passenger locomotives now in use in that the motors are geared to the axles instead of being flexibly mounted directly thereon.

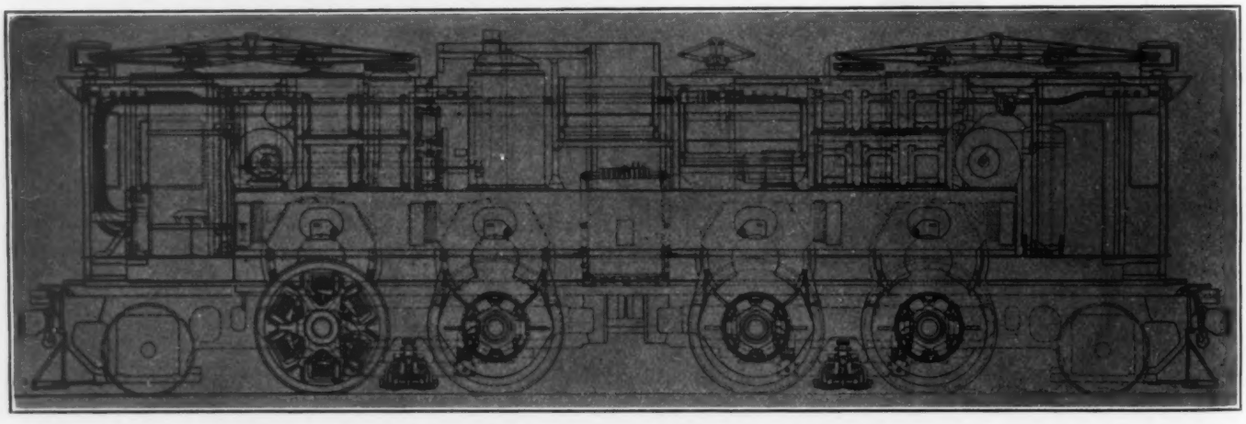


FIG. 1.—LONGITUDINAL SECTION OF ELECTRIC FREIGHT LOCOMOTIVE.

The motors are placed directly over the axles and are mounted solidly on the truck frames. Each end of the armature shaft is provided with a pinion; these mesh with gears mounted on a quill surounding the axle and carried in bearings on the motor frame, similar to the usual axle bearings. The quills are provided with six driving arms on each end, which project into spaces provided between the spokes in the driving wheels. Each of these arms is connected to an end of a helical spring, the other ends of the spring being connected to the driving wheels. This arrangement of drive smooths out the torque pulsations, and at the same time allows for vertical movement of the axles. In addition to the spring connection between the quills and drives, flexibility is provided between the pinions and motor shaft to equalize the torque on the gears. The quills are of large diameter, thus permitting unrestricted mo-

tion of the wheels and axles. The center of gravity of the motors, as well as that of the entire locomotive, is high, thereby avoiding the transmission of strains and shocks from the track and roadbed to the motors.

The motors are of the Lamme conductively compensated single-phase series type, similar to the motors on the earlier New Haven locomotives. They have 12 poles built into a solid frame, and are designed for forced ventilation. When operating on 25-cycle, alternating current, with forced ventilation, each of the four motors will carry continuously a load of 300 hp. An air-blast transformer is provided for lowering the trolley-line voltage to that required by the motors. The control apparatus is of the electro-pneumatic type, designed for use with 11,000-volt alternating current, or 600-volt direct current. When operating on alternating current, all four motors are connected in multiple and the control is obtained entirely by changing the connections to various voltage taps on the main transformer. On direct current the motors are first grouped all in series, and then two in series and two in parallel, in combination with various resistance steps. Provision is made for

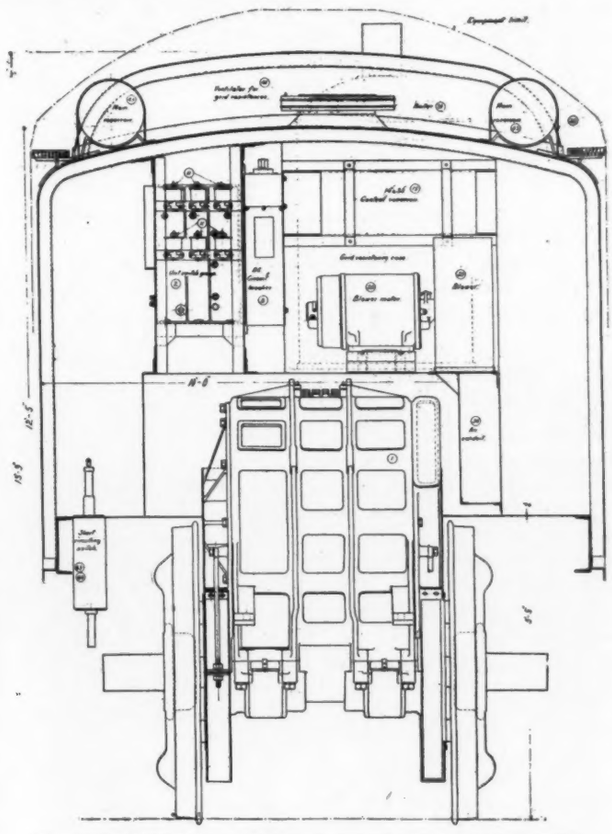


FIG. 2.—TRANSVERSE SECTION, ELECTRIC FREIGHT LOCOMOTIVE.

cutting out any one of the four motors singly on either alternating current or direct current.

A master controller and brake valve are located in each end of the cab so that the locomotive can be operated from either end, and the system of control is such that two or more locomotives of this type can be coupled together and operated from one master controller. The pneumatically operated pantograph trolleys are provided for collecting current from the 11,000-volt overhead alternating-current line. Pneumatically operated third-rail shoes are used to collect current on the direct-current third-rail section.

The locomotive will weigh approximately 260,000 lb., of which 188,000 lb. will be upon the driving wheels. It will be capable of hauling a freight train having a maximum weight of 1500 tons at a speed of 35 miles per hour. When used in passenger service, 800-ton trains will be hauled at a maximum speed of 45 miles per hour. A steam-heater outfit is provided on the locomotive for heating the cars of the trains when used in passenger service.

The drawings of the locomotive show the arrangement of control apparatus which, as will be seen, is located in the center of the cab with a passage on each side. The manufacturers expect to have the locomotive ready for service in the month of October.

CURRENT NEWS AND NOTES.

A. I. E. E. MEETING.—At the next meeting of the American Institute of Electrical Engineers, to be held on Oct. 8, Mr. John B. Taylor will present a paper entitled "'Telegraph and Telephone Systems as Affected by Alternating-Current Lines."

GEORGIA WATER-POWER.—The September issue of the *National Magazine* contains an article by Garnault Agassiz on the water-powers of Georgia. A number of these are described and the estimate given that the available water-powers of the State aggregate 500,000 hp at mean low water and 800,000 during the greater part of the year.

SAG IN TRANSMISSION LINES.—In an article by Mr. H. J. Glaubitz in our issue for March 25, 1909, entitled "A Quick Method for Determining Sags and Tensions in Transmission Lines," the definitions for the symbols x and x^1 should be interchanged. In the formulas derived, the former is the deflection in feet of the center of the cable at the temperature of erection, while the latter is the deflection in feet of the center of the cable when under the maximum stress.

CHARCOAL VS. ELECTRIC FLATIRONS.—A warrant has been sworn out for the arrest of an agent for a patent charcoal iron, who has created a peculiar situation in Clinton, Ind. A number of women who gave him orders for irons have been called up by the office of the local electric-light company, saying they want to exchange their charcoal irons for electric ones, declaring the agent told them "positively" that if they did not want to keep the iron he had arranged with the central-station company to take them in exchange for electric ones.

THE TELEPHONE FOR TRAIN DISPATCHING.—The Atchison, Topeka & Santa Fé Railroad has recently installed the telephone for train dispatching between Chicago and Newton, Kan., a distance of 659 miles. This equipment is but a small portion of what will be installed, it being the intention of the railroad company to extend this service over its entire system. At the present time there are 18 different divisions upon which the trains are dispatched by telephone. In this way 380 stations are reached in a total distance of 1925 miles. The Western Electric Company, which furnished the above equipment, has alone supplied over 50,000 telephones to various railroads throughout the United States.

PROPOSED BAVARIAN HYDROELECTRIC DEVELOPMENTS.—According to a consular report, the Bavarian Government will probably within the next few years commence the use of electric traction on its railroads. It is estimated that the water-powers of all the Bavarian rivers aggregate about 790,000 hp, of which about 425,000 hp would be needed if all the railway lines of the country should be electrified, and 600,000 if the lines it is proposed to build within the next 12 years are included. The introduction of electric traction will be gradual. Two plans for obtaining electric power in large quantities have recently been proposed. One is to take water from the Alz and conduct it by canal for 12½ miles for discharge into the Salzach, by which means a fall of 330 ft. would be secured, which would develop 25,000 hp for the whole year, or about 50,000 hp for about 200 days in the year. According to another plan, the waters from the Isar and the Riss would be conducted by separate canals into the Walchensee, a lake in the Bavarian Alps.

"THE GENERATOR."—The students of the New York Electrical School, 39 West Seventeenth Street, have begun the publication of a school organ named *The Generator*. Among the matter in the first issue is an article on dynamo and motor troubles.

BALTIMORE N. E. L. A. SECTION.—At the September meeting of the Baltimore Section of the National Electric Light Association Mr. Dorsey Smith, who has charge of the lamp room department of the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., read a paper entitled "The Incandescent Lamp." The meeting was one of the most successful of the season.

CHAIR OF ENGINEERING AT MELBOURNE.—The British consul-general at New York asks us to announce that the Registrar of the University of Melbourne invites applications from the United States for appointment to the chair of engineering in that university. The salary attached is £1,000 per year. Applications for the vacant chair should be made to the British consul-general at New York, and all papers, etc., required must be received not later than Oct. 15.

SELDEN GASOLINE AUTOMOBILE PATENT SUSTAINED.—On Sept. 15 Judge Hough, of the U. S. Circuit Court in New York City, handed down an opinion sustaining the Selden patent, which broadly claims the combination of a gasoline engine with a vehicle. The decision does not affect steam motor-vehicles, which were entering largely into use just before the advent of the steam locomotive, nor electric automobiles, as no one appears to have thought of covering the latter with a combination patent. The decision will be appealed.

BRITISH ILLUMINATING ENGINEERING SOCIETY.—It is announced that Prof. S. P. Thompson has consented to become first president of the British Illuminating Engineering Society, recently organized. Among the vice-presidents are Drs. Louis Bell, A. H. Elliott and E. P. Hyde, of this country; Sir William Crookes and Profs. J. A. Fleming and Vivian Lewis, of England; Profs. A. Blondel and St. Claire Deville, of France; Drs. Emil Budde, H. Bunte and W. Voege, of Germany. The society will hold its opening session in November. The secretary is Mr. L. Gaster, 32 Victoria Street, London.

WINNIPEG (MAN.) ELECTRIC LIGHT SITUATION.—The controversy between the city of Winnipeg and the Winnipeg Electric Company is in much the same position as reported last week. It is understood the city is still refusing to issue permits for the erection of electric-light poles and the company has not made any application for permits, but is erecting the poles on its own responsibility. It is reported that the city electrician will be instructed not to issue any permits for wiring done in houses connected with pole lines which have been erected without civic permits.

GROWTH OF TELEPHONE BUSINESS IN CHICAGO.—Improvement in general business conditions seems to be indicated by the increasing number of new telephones installed by the Chicago Telephone Company. During August, 1909, the company put in 3770 telephones as compared with 3334 instruments for the corresponding month in 1908. The total number of telephones now in service in Chicago is 195,744, as compared with 173,472 a year ago. The total number of telephones connected to the whole system of the Telephone Company, both city and suburban, is 248,669, an increase for the year of 26,756.

A GREETING BY SCHOOL CHILDREN.—Sept. 16 was "Taft Day" in Chicago, so named from the visit of the President. One feature was the assembling of school children on the streets traversed by the distinguished guests in entering the city. It is said that 150,000 children greeted Mr. Taft in this manner. About 16,000 of the pupils were carried by the Chicago City Railway Company to and from their assigned destinations on the line of march without payment of fare at the time on showing their school badges. Afterward the Board of Education paid 5 cents each for the round trip of the school children, the teachers collecting the fare from the boys and girls.

PROPOSED MUNICIPAL PLANT FOR BALTIMORE.—Mr. Robert J. McCuen, superintendent of lamps and lighting, of Baltimore, Md., has for some months past been actively engaged in securing data of municipal lighting plants as operated in other cities, and will presently make a lengthy report on the advisability of erecting such a plant in Baltimore in view of the expiration of the present contract which the city has with the Consolidated Gas, Electric Light & Power Company. Under the present contract Baltimore is getting the benefit of very low rates, paying now $67.49 per street lamp that at one time cost as high as $125. Should the present rate be continued the installation of a city plant will probably not be considered.

ELECTRIC PUMPING FOR NIAGARA FALLS.—The board of water commissioners of Niagara Falls, N. Y., has decided to accept the offer of the Niagara Falls Hydraulic Power & Manufacturing Company to supply electric current necessary for the operation of its proposed new municipal water-pumping station for a term of 76 years. A part of the agreement is to be that the city will sell the power company the property in the lower milling district on which the municipal station now stands for $20,000. Over 800 hp will be acquired, the price to be $10 per horse-power. The engineer of the water board will see what arrangement can be made with the Niagara Falls Power Company for a breakdown power service. The city is engaged in building a new water system, the supply of which is to be taken from the upper river, whereas in the past the municipal plant has been supplied from the hydraulic canal.

TUNGSTEN VS. NAPHTHA STREET LAMPS IN BALTIMORE.—The Department of Lamps and Lighting, of Baltimore, Md., has announced that it is considering the installation of incandescent electric lamps in sections of the city now lighted by naphtha lamps. A report favoring the substitution has been made to the board of awards, and is now being held under advisement. It is recommended that the gas and electric company be given a five-year contract for energy for tungsten street lamps, which the company has offered to supply at $27.45 a lamp per annum from overhead wires, and $52.45 per lamp connected with the underground service, offering, however, to take off $20 per lamp if allowed to use the present arc cables in providing the incandescent service. In cases where the city owns the fixtures and has its own cables in the conduits, the company will furnish the service at $27.45 per lamp. This applies to the parks and boulevards.

BRITISH PATENTS ACT.—A U. S. consular report states that the result of the first year's working of the British patents act has been that $2,500,000 of foreign capital has been introduced into the United Kingdom, as the following indicates: The value of the land and premises acquired by foreign firms who have decided to carry on their manufactures in this country in order to maintain patent rights is estimated at $635,000. The expenditure for buildings was $880,000; plant and machinery, $895,000, making a total of $2,410,000. The annual local assessments on these new enterprises is estimated at $135,692. In addition, it is stated that a great many firms have arranged for English factories to manufacture their patented articles on a royalty basis. A specialist in factory property stated in a recently published interview that his firm was in negotiation with several German and American firms for the acquisition of sites and factories, principally in the chemical, engineering, electrical, and rubber-making trades, and that a French firm of pottery makers are seeking a site for a model village. He estimated that 24 firms are already manufacturing in Great Britain as a result of the act.

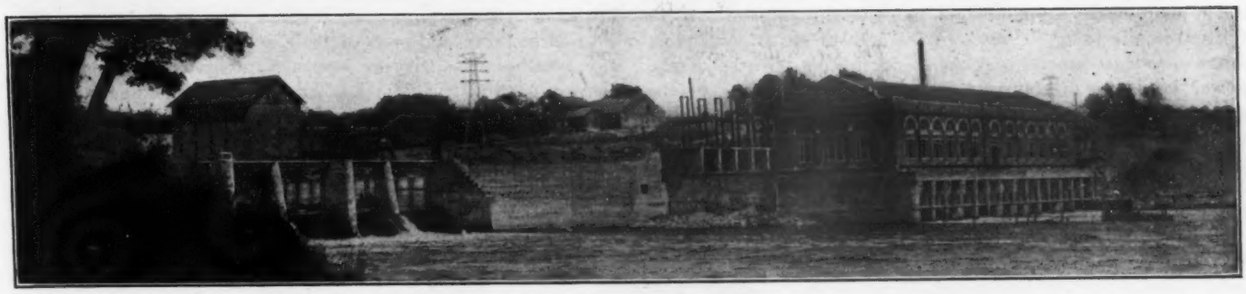


FIG. 1.—DOWNSTREAM SIDE OF SOUTHERN WISCONSIN POWER HOUSE FROM OPPOSITE BANK.

Hydroelectric Development on the Wisconsin River Near Kilbourn, Wis.

FOR many years the Dells of Wisconsin on the Wisconsin River near Kilbourn, Wis., have attracted many visitors by the beauty of the scenery. The river is contracted between rocky walls, and the shore formation, the curious rock shapes, the caves, and the rushing waters are decidedly picturesque. The water-power possibilities of the locality have also long been recognized, but it is only recently that a modern plant utilizing the volume and head of water for the generation of electricity has been placed in service by the Southern Wisconsin Power Company. The plant is rated at 6000 kw, and a brief description of it was published in the June 24 number.

It is expected that about 84,000 kw-hours per day will be delivered from this development over a 70-mile transmission line extending to a connection to the system of the Milwaukee Electric Railway & Light Company at Watertown, Wis. The latter company in turn will transmit the electrical energy about 50 miles farther to its center of distribution in Milwaukee, thus making the total length of transmission 120 miles. The new plant will be operated in parallel with the existing steam stations of the Milwaukee company. Considerable electrical energy will also be sold locally and along the transmission line. It is proposed to increase the size of the plant at a later date.

FIG. 2.—INTERIOR VIEW OF THE POWER STATION.

The character of the Wisconsin River is such that this stream is one of the most favorable in the Middle West for power development. The drainage basin above the site at Kilbourn covers approximately 7800 square miles and contains numerous lakes and large tracts of sandy country, while most of it is wooded. A steady run-off with a comparatively limited variation between the minimum and flood flows is consequently produced. The ordinary minimum flow is between 4000 cu. ft. and 5000 cu. ft. per second, and flood discharges of 40,000 cu. ft. to 45,000 cu. ft. per second may be expected in ordinary years, with an exceptional volume of 80,000 cu. ft. per second, or more, at long intervals. The minimum and maximum conditions are usually of comparatively short duration, however, and the average flow is well maintained.

A 90-deg. bend in the river, where a series of rapids formerly existed, forms a favorite location for the hydraulic development. A dam has been built across the channel, which was about 350 ft. wide at the power site, to develop a head of 17 ft. The power house with its headrace and penstocks is in an excavation made in solid rock on the left-hand, or east bank, of the stream entirely outside the channel. With the head, volume of water and pondage available, the present generating equipment can be operated throughout the year on a 10-hour or 14-hour basis, and during the most of the year the flow is such that a much greater output can be obtained. Hence, the installation of the proposed additional units is quite desirable, since the existing dam is sufficient to provide for them, and the expense involved in extending the head-works would be relatively small. At the same time these units would be of advantage as reserve. Furthermore, not only can all of the equipment of an enlarged plant be operated much of the year, but the existing steam plants in Milwaukee also are available for auxiliary power during periods of low flow.

At the site the stream flows through a continuous formation of Potsdam sandstone, the bed and both banks being of this material. The original depth of the river at the site of the dam ranged from 25 ft. to 35 ft., and its width was 350 ft., with both banks rising straight up to a height of 50 ft. to 70 ft. from the edge of the water. These conditions, combined with the large volume of flood discharge, required the full width of the channel to be utilized as a spillway. The power house, therefore, had to be placed in the excavation in one bank, where it is protected from flood. This location of the power house at the angle of the bend of the stream also secured considerable advantage in head by separating the tailraces from the discharge over the spillway.

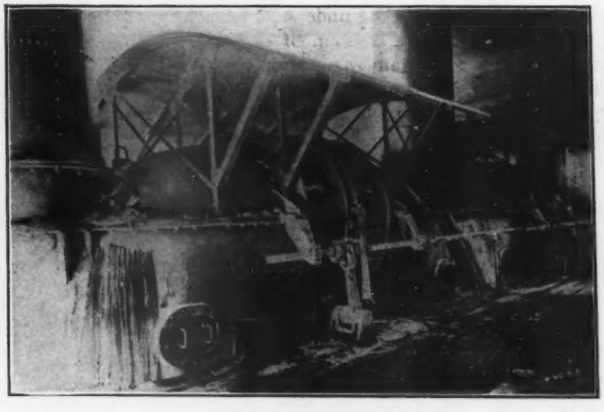


FIG. 3.—UMBRELLA COVERS OVER THE PAIRS OF TURBINES.

The dam across the river is a concrete structure on a rock-fill timber crib base. It has a total length of 400 ft., extending from a wide abutment wall adjoining the head works of the power house to an abutment built into the rock face of the opposite bank, and rises to a maximum height of 55 ft. above the bed of the stream. The dam is 48.5 ft. wide at the bottom. The concrete superstructure of the dam is built as a spillway, with its crest 6 ft. below the level at which the headwater in the pond above it will be maintained. Concrete piers placed 25 ft. 10 in. apart in the clear rise from this spillway to a height of 24 ft. above the latter, thus providing 12 large openings, with a total clear width of 300 ft., through which is passed all of the flow not utilized in the power house. Each of these openings contains a large vertical steel gate designed as a crest of adjustable height by means of which the water above the dam will be held at the stage desired. The lowering of the gates also will permit flood flows to be passed without raising the level of the pond beyond certain limits.

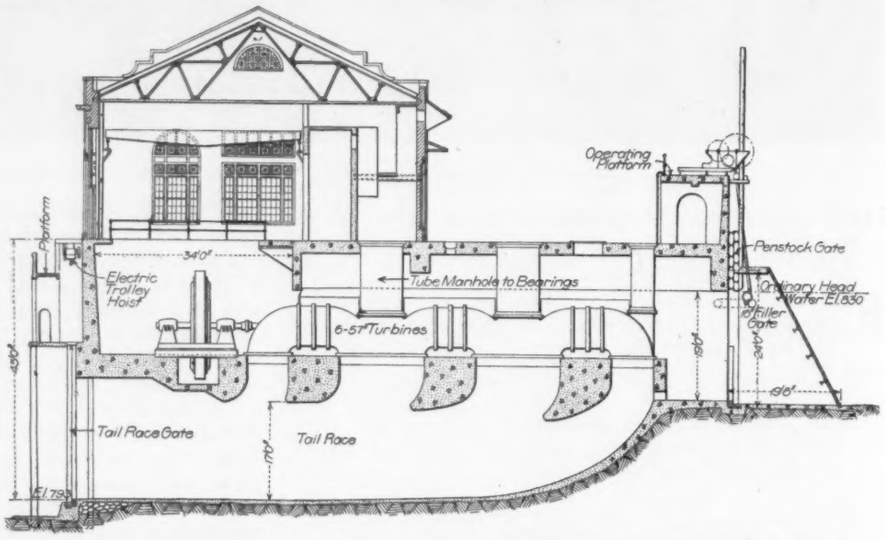


FIG. 5.—CROSS-SECTION OF GENERATING STATION THROUGH ONE MAIN PENSTOCK.

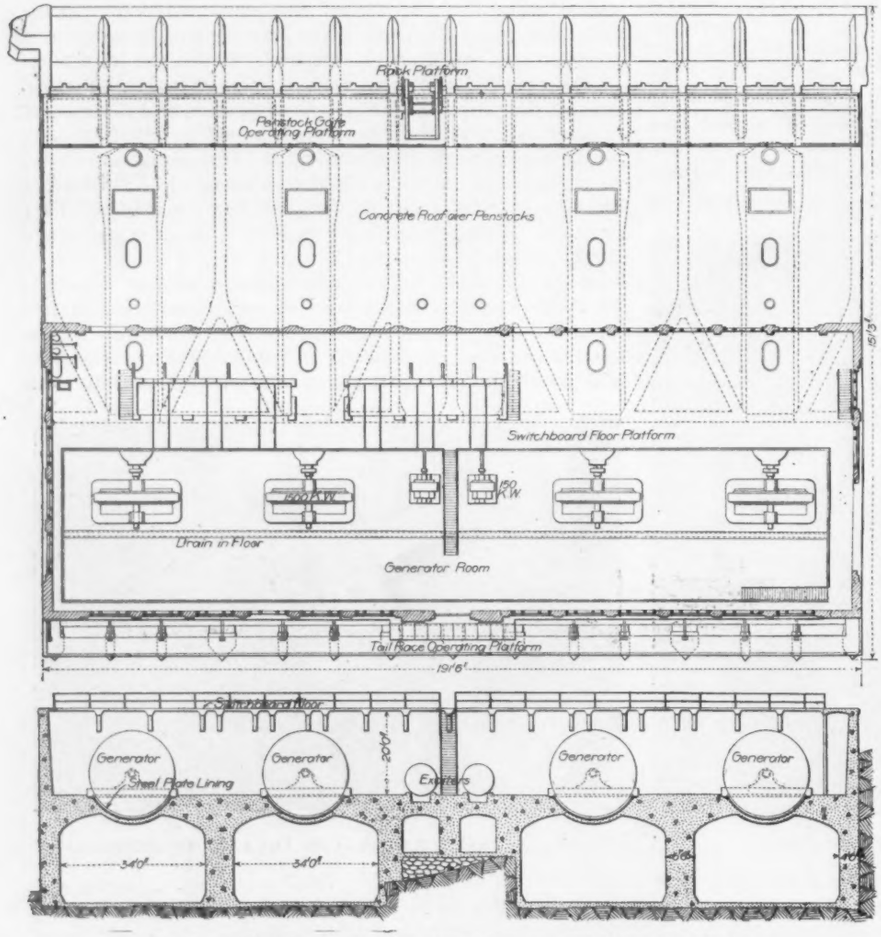


FIG. 4.—PLAN VIEW AND PART ELEVATION OF GENERATING STATION.

All the hoisting gears of the gates are arranged to be driven independently or collectively from a lineshaft 350 ft. long that extends the full width of the dam. This shaft, 2 13/16 in. in diameter, is geared to a 15-hp electric motor placed in a small brick house at the power house end of the dam. It is divided into 12 sections, and each of these sections, by means of friction clutches, can drive an intermediate shaft 24 ft. long. On these intermediate shafts are mounted the operating gears of two hoists to each gate. The hoists also are built so they can be operated by hand in an emergency.

Gates of this type were installed in preference to the bear-trap or any other movable-crest design on account of the large amount of sand carried by the stream. The accumulation of sand under the bear-trap gate has been found to cause much difficulty in other places where force enough to scour it out is not available.

Such parts of the spillway section as are exposed to ice are protected against damage. In order to cause cakes of ice to rise and ride over the dam, the upstream side of the gate openings are stepped, and in these steps are placed 12-in. x 12-in. timbers beveled and shod with steel plates. The crests of the gates are considered to be amply strong for any conditions that may arise. The curved face of the concrete on the downstream side of these gates is protected by 14-ft. lengths of old rail embedded in it, 2 ft. apart on centers, and following its curve. Beyond the end of the rails a plane of reinforcement consisting of ½-in. round rods, spaced 2 ft. apart in both directions, is designed to prevent damage to the concrete, and to provide for any stresses due to unequal settlement or other causes. Provision is made to shut off any one of the openings by means of vertical needles, in order that the gates may be reached and repaired.

A head-gate section, 120 ft. in length, extends upstream from the abutment at the power-house end of the dam, as shown in the accompanying general plan. The penstocks and the power house of the development occupy together an area 143.25 ft.

wide by 191.5 ft. long at the downstream end of the head-race, and are in an excavation that is a continuation of the one made for the latter. The penstocks and the substructure of the power house, which includes the tailraces, are built entirely of concrete on a foundation of solid rock. The power house

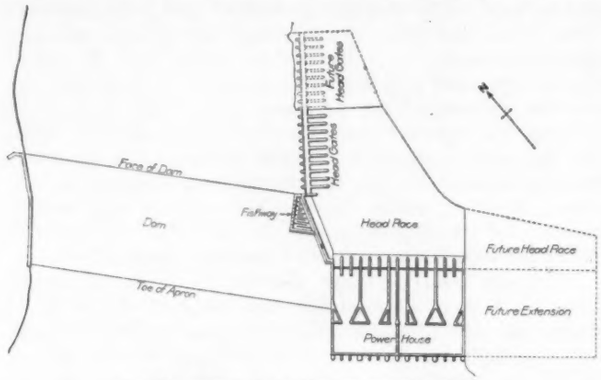


FIG. 6.—GENERAL PLAN OF DEVELOPMENT.

contains four main generators and two exciter units, waterwheels for each unit being placed in an individual penstock. The six separate penstocks thus provided are all built together in a row with concrete division walls between them. Two exciter penstocks, each 11 ft. wide in the clear, are at the middle of this row, with those for two main units, each 38 ft. wide in the clear on both sides of them. The gates controlling the entrances to the penstocks are in a continuous row along the upstream ends of the latter. Each of the small penstocks has a single gate, while three separate gates are provided for each of the larger ones.

The penstock gate openings are 19 ft. high by 11 ft. wide, and are each controlled by a steel grate in two parts; the lower leaf is 10 ft. 3 in. high and the upper left 9 ft. 10½ in. The lower gate seats on the bottom of the opening, and at the top overlaps the upper one 3 in. Stems attached to the outer side of the lower gate of each pair provide for the operation of the two by means of a rack and pinion driven through gears on a platform carried by the piers. The lower gate is raised until brackets on the inside of the bottom of it engage the bottom of the upper gate, and then the two are drawn up together. The rock-and-pinion mechanism is operated by means of a motor-driven crab traveling along the platform over the ends of the penstocks. A 16-in. inlet to each penstock is provided, in order to permit the pressure on the gates to be balanced before an attempt is made to open them. This inlet is fitted with a sluicegate controlled by hand from the operating platform.

The penstocks are 78 ft. long and extend 21 ft. inside the power house. They are covered 8 ft. above the ordinary level of water in the headrace with a tight reinforced concrete roof. The portion of the substructure of the power house not included in the penstocks also has tight reinforced concrete walls built to this height. The superstructure of the building is of pressed brick trimmed in stone and covered with a roof of red Ludowici tile carried by steel trusses. Skylights of glass tile placed in the roof provide, together with ample windows, good interior lighting.

On the downstream side of the interior of the building is the generator room, 34 ft. wide, that extends the full length of the building, with a clear height of 44 ft. under the roof trusses. The flat roof of the penstocks forms the floor of the remainder of the building at the rear, with a clear height of 24 ft. between it and the roof trusses. On this floor are placed the transformers, switching connections, switchboards and various auxiliary apparatus of the plant.

The waterwheels are of a modified McCormick type turbine, built and installed by the Wellman-Seaver-Morgan company, of Cleveland, Ohio. Each main generator is driven by six 57-in. turbines arranged in pairs on a single horizontal shaft. The six wheels of each set are designed to be capable of driving a 1500-kw generator at 25 per cent overload at 100 r.p.m., the generator having an efficiency of 90 per cent. The design provides that each six wheels will develop a maximum of 2778 hp when running 100 r.p.m. under 17 ft. effective head, and when operating under 12 ft. effective head will produce 60 per cent of the full capacity. The wheels at the two ends of the shaft discharge outwardly through separate quarter turns and draft tubes, while the other four wheels are arranged so the quarter turns for each two adjacent are combined into one draft tube. Four of the latter thus enter the tailrace, and the wheels are operated so that the thrust of each two is counter-

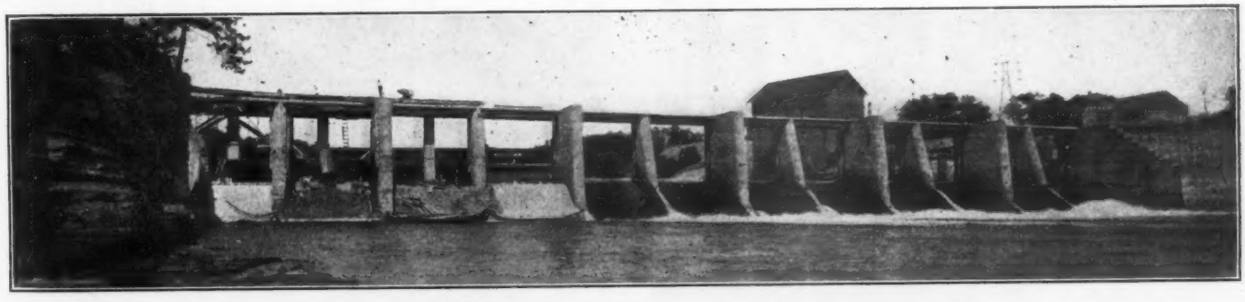


FIG. 7.—SPILLWAY SECTION OF DAM BEFORE GATES WERE PLACED.

balanced. For emergencies one thrust bearing is provided next to the generator, but it has been found in operation that there is always play in both directions at this bearing.

The turbine shaft extends through a packing gland in a bulkhead in the downstream end of the penstock, and is direct-connected to the shaft of its respective generator. It is in three

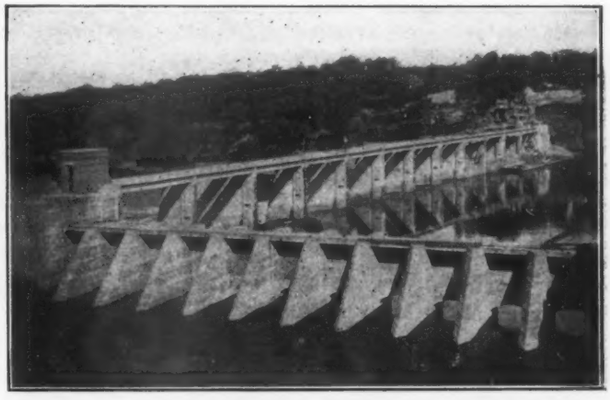


FIG. 8.—HEADGATES AND SPILLWAY SECTION OF DAM DURING CONSTRUCTION.

sections, with one pair of gates mounted on each of the latter. The end section is of open-hearth steel, the middle one of nickel steel, and the one next to the generator of annealed nickel steel. This difference was made to obtain the greater

strength required to transmit the power of each additional pair of turbines without increasing the size of the shaft.

The gates of each set of turbines are controlled by a Lombard governor placed on the floor of the generator room. Power is transmitted from the governor to the gates by means of two cold-rolled steel draw rods connected to the shifting ring by cast-steel links and segments. These rods pass through packing boxes in the bulkhead at the end of the penstocks and are connected to the driving mechanism of their governor, which is located on the floor of the generator room.

Over each pair of runners is a curved steel umbrella cover designed specially for this installation, to prevent the formation of a vortex in the water over the turbine and the consequent admission of air to the latter. Each of these umbrella covers is carried by a light steel frame seated on the quarter turns of the turbines, and has a minimum clearance of 18 in. over the latter. Before the covers were adopted extensive experiments were made in the hydraulic laboratory at Holyoke, Mass., to determine their value. These investigations indicated that the use of covers of this type would permit the turbines to be placed much nearer the surface of the water, without reducing their efficiency, than if the covers were omitted. In this particular installation the wheels accordingly have been set between 3 ft. and 4 ft. above the limiting height for turbines of this type that operate without protection against the formation of a vortex above them. The results of the tests also showed that the employment of such covers will allow horizontal turbines to be installed for lower heads than have heretofore been considered practicable.

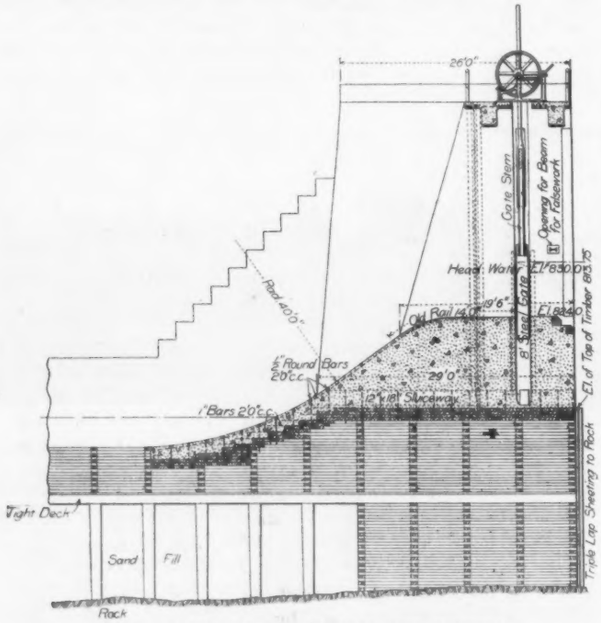


FIG. 9.—CROSS-SECTION OF DAM AND FISHWAY.

Each shaft is provided with six oil-ring bearings, one in each of the quarter turns and one in connection with the thrust bearing of the generator. These bearings are all supplied with oil from a pipe line under pressure from pumps at the generator floor level. Steel inspection tubes extend from manholes in the floor over the penstock down to each bearing in order that any one of the latter may be reached at all times.

Each exciter unit is driven by a pair of 33-in. Jolly-McCormick turbines set on one shaft. These turbines are designed to develop 250 hp when running at 200 r.p.m. under a 17-ft. head. Their efficiency is guaranteed not to drop more than 2.5 per cent from a full gate to a three-fourths gate opening. The operation of each pair of these turbines is controlled by a Lombard governor.

The tailraces of the main units are 34 ft. wide and have arched tops which span between the division walls of the penstocks. These arches form the floor of the generator room and carry to the sidewalls the heavy loads on that floor. The division walls between the adjacent tailraces are extended 9.25 ft. beyond the downstream face of the power house, and between the projecting ends of each two of these walls that are adjacent are placed two intermediate piers spaced equal distances apart. The downstream end of each main tailrace is thus divided into three openings, each 10 ft. wide and 21 ft. high in the clear.

Two-part gates very similar in design to those used to control the entrance to the penstocks are provided to close the ends of the tailraces. The tops of the intermediate piers and the projecting ends of the division walls are connected by a continuous concrete slab, on which piers are erected to carry the track of an electrically operated traveling hoist used in raising and lowering the gates. A continuous platform from which the hoist is operated also is placed on these piers.

The main generators are 1500-kw, 2300-volt, three-phase, 25-cycle General Electric machines designed to operate at 100 r.p.m., with a 90 per cent power factor. They are separately excited and Y-connected with the neutral brought out. The design provides for a 25 per cent continuous overload and 50 per cent overload for a period of one hour without an excessive rise in temperature. The shaft of each machine is mounted on two bearings carried by a base seated in the concrete floor of the room. A pit 5.75 ft. wide, and with a curved bottom giving it a maximum depth of 5 ft., is placed in the floor under each generator, in order that the shaft might be set at the proper height. This pit is lined with steel plates embedded in the concrete to make it water-tight.

Trenches are built in the floor of the generator room to collect and deliver to a sump any water that may reach that floor. Two motor-driven 3-in. pumps have been installed to lift the water from this sump and discharge it outside the building. These pumps are placed in niches provided on the upstream side of the generator room by the converging ends of the penstocks.

Two motor-driven 10-in. submerged centrifugal pumps are installed to unwater the tailraces in case the latter have to be entered. One of these pumps is placed in the sump in a niche between the penstocks of the two main units, and the second is in a similar location between the other two main penstocks. Both pumps can draw from the race on either side of them and discharge through a pipe laid in the floor to a point on the downstream side of the power house.

The operation of the generators, switching connections and auxiliary electrical apparatus installed in connection with them is governed from a remote-control switchboard. The latter is on the floor formed at the rear of the generator room by the roof of the penstocks, and is placed toward the river end of the building, where it will be located about midway between the two ends of the final building when the proposed extensions are made. The floor is carried 6 ft. over the wall of the generator room, and the board faces on this gallery, from which all of the equipment in the room can be seen.

Leads from the generators are carried to niches in the rear wall of the generator room in conduits embedded in the floor, and are thence connected to 2300-volt buses on the second floor at the rear of the building. Two complete sets of these buses with separate oil switches are installed on this floor directly over the switchboard. These buses are arranged so either of them may be operated entirely independent of the other, and both of them have sufficient capacity to serve all four main units. The current from each of the generators can be delivered to either set of buses independently.

Two banks of single-phase, 1000-kw, water-cooled General Electric transformers are installed to step the potential up to the transmission voltage. The three transformers in each of these banks are placed in adjacent separate compartments having concrete walls and tops with their front ends opening on the operating gallery. Each transformer is mounted on a four-wheeled truck on rails laid in the floor so it can be run out on the gallery under the range of a 30-ton hand-operated traveling crane that commands the entire floor of the generator room.

Cooling water for these transformers is furnished by pumps installed in the niches off the rear of the generator room. These pumps are in duplicate, and are arranged so they can draw a supply from any one of the four main penstocks. They discharge into separate piping systems, which are interconnected to permit any one of the three pumps provided to deliver to either or both of the two banks of transformers.

The 2300-volt current is delivered to the transformers from the buses through varnished cambric cables. The latter, reaching to the more remote bank, are placed together in a pipe suspended from the roof trusses, but only a short length is required to reach the other bank. The transformers are at present designed to step the voltage up to 44,000 volts, but in the future this voltage will be raised to 70,000 volts. Two transmission lines lead out of the station, and the connections for both banks of transformers are arranged so either or both of them can deliver to either or both lines.

All of the 2300-volt and 44,000-volt buses, oil switches and auxiliary apparatus are placed in separate fireproof compartments. The compartments for the 2300-volt buses with their corresponding oil switches are placed together, but are so separated that either set of them can be operated entirely independent of the other.

The duplicate transmission lines of this company, extending a distance of 70 miles to Watertown, are carried on one set of steel towers, built by the Aermotor Company, of Chicago. The towers range from 60 ft. to 90 ft. in height, and under normal

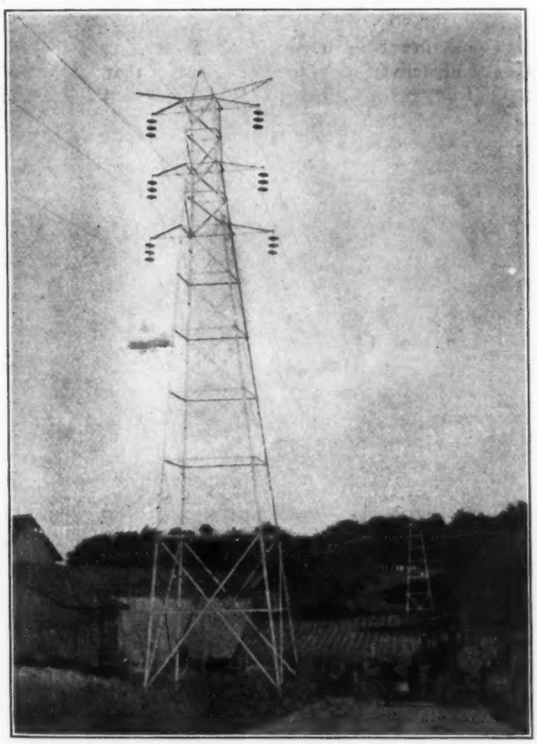
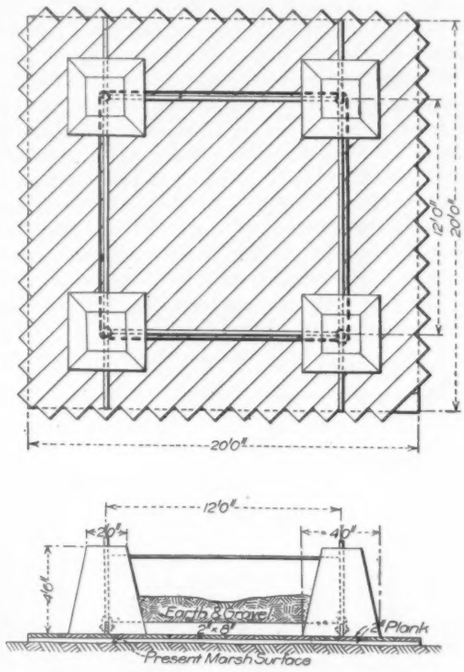


FIG. 10.—A VIEW OF THE TRANSMISSION LINE.

conditions are spaced 10 to the mile. The base of the leg of each tower is anchored to a concrete pedestal 2 ft. square at the top, 4.5 ft. high and 4 ft. square at the bottom. As the line crosses a large number of swamps, the provision of a satisfactory foundation for the base of these tall, heavy towers involved serious difficulties. The pedestals are placed at the corners of a 12-ft. square, and where marshes were encountered a platform, consisting of two layers of 2-in. plank placed diagonally with respect to each other, was laid on the existing surface of the marsh. The anchor bolt to which the bottom of each tower leg is fastened was then attached to a 2-in. x 8-in. plank spiked on edge to this platform, and each extending the width of the latter. Then the concrete pedestals were built up around these anchors. The pedestals also were tied together around the sides of the square by ½-in. rods warped around the anchors 6 in. below the top of the concrete.

The transmission wires are hung from brackets on opposite sides of the tops of the towers by means of suspension insulators. The three wires of each line are in a vertical plane in



FIGS. 11 AND 12.—PLAN AND SECTIONAL ELEVATION OF TOWER. PLATFORM IN MARSHES.

which they are spaced 72 in. apart. Stranded Roebling cables, consisting of six No. 0 hard-drawn copper wires around a hemp center, are used. The insulators are of the Thomas petticoat suspension type, 12 in. in diameter, and are designed to withstand pressures up to 75,000 volts. They also were built to stand a test of 53,000 volts with water dropping on them at the rate of 1 in. in five minutes at an angle of 45 deg. In strength they were required to stand a direct pull of 5000 lb.

The officers of the Southern Wisconsin Power Company are: President, Mr. M. Swenson; Mr. H. P. Broughton, chief engineer; Mr. Daniel W. Mead, chief engineer. The power development was designed and built under the immediate direction of Mr. Mead, and Mr. C. V. Seastone, as principal assistant engineer, had charge of the design and construction. Mr. R. C. Walter was resident engineer during the construction of the plant. The electrical equipment of the entire development was furnished and installed by the General Electric Company. Mr. George M. Brill, of Chicago, was consulting electrical engineer.

Self-Starting Single-Phase Motor.

A patent issued Sept. 14 to Mr. B. G. Lamme describes a resistance-lead arrangement and short-circuiting scheme for starting a single-phase motor as an eight-pole commutator machine and operating it as a four-pole induction motor. The stator winding is arranged to produce either eight or four magnetic poles, as desired. The pitch of the armature coils is intermediate the polar pitches for the larger and smaller number of field poles, and is of such a value that the maximum obtainable e.m.f. is given in the armature for both number of poles. In order to reduce the amount of sparking when starting or running at low speed as an eight-pole commutator machine high-resistance leads are inserted between the commutator segments and the armature coils, which are closed upon themselves. For the purpose of short-circuiting the rotor winding upon itself when operating at high speed with four poles, cross-connectors join together the terminals of armature coils that have equipotential position when operating with eight poles.

Oakland (Cal.) Steam Auxiliary Station for Great Western Power Company.

THROUGH an affiliated corporation, the Great Western Power Company, of San Francisco, has almost completed a steam-operated power station for generating electricity at Oakland, Cal., across the bay from San Francisco. As described in the Aug. 26 and Sept. 16 issues, the Great Western Power Company operates about 180 miles of transmission lines for bringing to San Francisco and other cities power developed from water-powers in California. Although installed primarily as a reserve plant, there being also a terminal station in Oakland, no effort has been spared to secure a high standard of efficiency and reliability to meet the severe requirements of operation that are imposed on a plant of this kind. It is expected that the first unit will be ready for service about July 1, the remainder of the initial installation coming into use later.

In the choice of equipment apparatus has been selected which represents the principles of late development in central-station practice. The station will contain three 3500-kw horizontal Curtis turbo-generators, with space for a fourth unit of the same size. Electricity at 11,000 volts, three-phase, 60-cycle will be generated, and part of it will be transmitted to the Oakland substation of the Great Western Power Company, the remainder being distributed directly from the generating plant. Simplicity is a marked feature of this plant. The general arrangement may be seen by reference to the accompanying drawings, showing a plan and cross-section. Fuel oil will be burned under the boilers, and although it is expected that at first the plant will be operated only a part of the time, as needed, it may be run continuously or quickly put into operation or shut down, as the demands of the business may require.

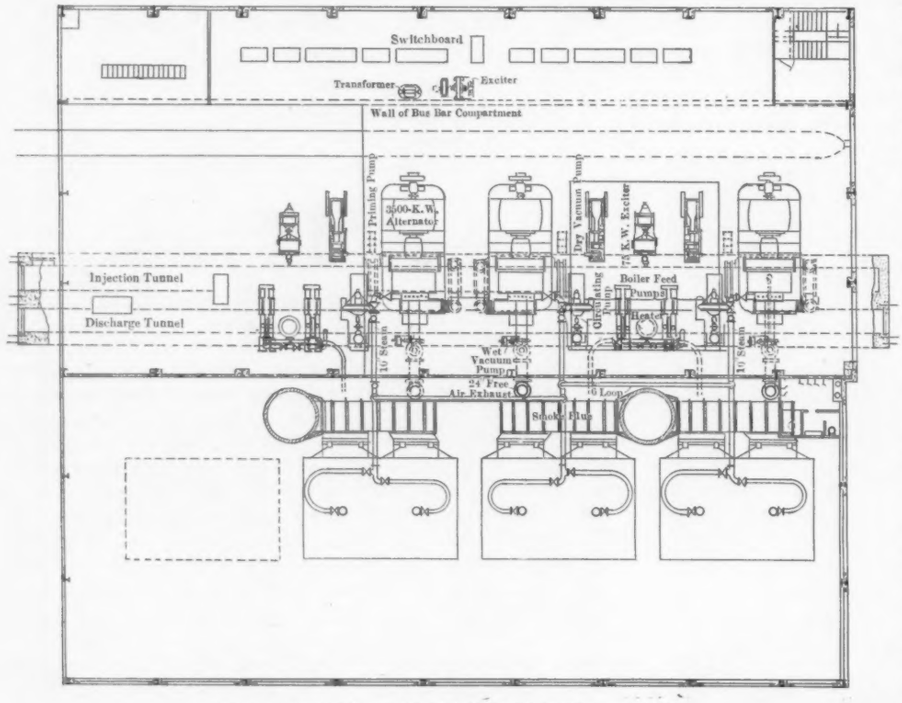


FIG. I.—GENERAL PLAN OF OAKLAND POWER STATION.

Several features in the design of the station building are unique, and it is believed that the structure is well adapted for the purpose for which it is planned. The building is nearly square and is about 155 ft. x 134 ft. in ground dimensions. The foundation consists of a reinforced-concrete monolith, 6 ft. thick, supported on piles driven about 3 ft. apart throughout the entire building area. The machinery may be placed on this concrete foundation in any position desired. The superstructure is of steel-frame construction, with reinforced-concrete walls. Very large windows are used, and these, together with the skylights and monitors, will give an abundance of light and air. The windows, doors, skylights, etc., are constructed entirely of metal and wire-glass, there being no wood or other inflammable material used in the entire structure. A light steel framing is placed in all walls between the main columns. This framing conforms to the outline of the building, and furnishes a support for the metal-lath reinforcement. The concrete was put on in the form of plaster and applied from both sides.

It will be noted that the boilers are laid out in a line parallel to and occupying the same relative space as the turbines. The arrangement of machinery is such as to make each unit independent. The condenser auxiliaries, boiler-feed pumps and the feed-water heater serving two units are grouped together, thus reducing the necessary operating attendance. As shown in the cross-section drawing, there is a basement under the turbine-room, and the floor of this basement is on the same level as the floor of the boiler-room. The condenser for each turbine is located immediately beneath it in an opening provided in the foundation, making a very compact arrangement. As the plant is located on San Francisco Bay, salt water is used for condensing purposes. The arrangement of the circulating water tunnels, especially in the construction of the center partition, is such as to minimize the amount of excavation and concrete work.

Fuel oil will be relied upon exclusively for the operation of the station. The main storage tank will have a capacity of 10,500 bbl., and will supply auxiliary storage tanks immediately adjacent to the building. From these tanks the oil is piped to the boiler furnaces, and there are four Hamill oil burners for each boiler. Six Babcock & Wilcox boilers will be installed. They will have 6000 sq. ft. of heating surface each. These boilers will be of the vertical-header type, of steel construction throughout, and designed for a maximum operating pressure of 225 lb. per square inch. Superheaters will be provided with sufficient surface to maintain 125 deg. Fahr. when the boiler is operating at or near the rated output.

Two self-supporting steel smokestacks will be installed, each of sufficient capacity for four boilers. These stacks are 9 ft. 6 in. inside diameter and 150 ft. in height above the boiler-room floor. The smoke flues, which are of steel construction, are provided with sliding cut-off dampers, in addition to the butterfly damper at the outlet of the boiler, for cutting down the standby losses.

Three horizontal Curtis turbo-generator units are furnished by the General Electric Company. These machines have a maximum continuous rating of 3500 kw each, and are designed for operation at a steam pressure of 210 lb. with superheat at 110 deg. Fahr. The steam turbines are five-stage machines. The generators have six poles and are wound for delivering three-phase, 60-cycle current at a potential of 11,000 volts. Ventilation of the windings is provided by a small blast fan mounted on the end of the shaft. The field rheostat and the governor of the turbine are both arranged for remote electrical control. Lubrication of the bearings will be accomplished by means of an oil pump geared to the main shaft. An oil reservoir is arranged in the face of the turbine and provided with the necessary cooling coils. The principal dimensions

of the turbo-generator are as follows: Length over-all, 30 ft.; width, 14 ft.; height, 12 ft. The total net weight is 250,000 lb. Special interest attaches to these units from the fact that they are the largest horizontal machines of the Curtis type which have been installed up to this time. The speed of operation is 1200 r.p.m.

Three 75-kw exciters are to be provided. Two will be driven by small Curtis steam turbines, and the third by an induction motor. The electrical energy for this motor, as well as for the motors for an overhead traveling crane in the turbine-room, will be supplied from a 110-kw, 11,000/400-volt transformer.

The condensing equipment for the plant will consist of three 8000-sq. ft. Alberger counter-current condensers. Each condenser will be furnished with auxiliaries as follows: One 16-in. centrifugal circulating pump, designed for a capacity of 6800 gal. per minute, and driven by a vertical enclosed Blake engine; one rotative single-stage dry-vacuum pump, and one turbine-driven centrifugal wet-vacuum pump. Connection between turbine and condenser is made by means of a corrugated copper Wainwright expansion joint, which provides for the expansion and contraction due to changes of temperature. One rather interesting feature of the condenser arrangement consists in the location of the atmospheric exhaust, which is connected directly into the upper part of the condenser shell, thus obviating the necessity of allowing the extra clearance space for a separate exhaust connection.

All the auxiliaries are designed for operation under the conditions of pressure and superheat mentioned for the turbines. Independent pumps have been provided for priming the condensers, so that no salt water will enter the boilers. As an additional safeguard against fouling the boilers, the closed type of feed-water heater has been selected, thereby eliminating the possibility of oil finding its way into the boiler. The arrangement of the plant is such that one heater will take care of the supply for two of the turbines. These heaters are of cast-iron construction and cylindrical in shape. The heating surface consists of 1600 sq. ft. of brass tubing, ¾ in. in outer diameter. The arrangement is such that the water makes two passes through the heater.

The boiler-feed pumps will be of the duplex outside-end-packed type, designed for a capacity of 250 gal. a minute. The water ends of these pumps are of steel construction and provided with bronze plungers. These pumps are supplied by the Epping-Carpenter Company.

Although not shown on the drawings, the station will be equipped with a 30-ton, four-motor, overhead traveling crane, with 5-ton auxiliary hoist. The Niles-Bement-Pond Company, contractors for the crane, will equip it with three-phase, 440-volt induction motors.

Simplicity characterizes the piping layout. In the arrangement of the live-steam piping, a 10-in. header serves to connect each turbine with two boilers. These headers are tied together by 6-in. loops. Four-in. auxiliary steam headers are connected directly into the main headers adjacent to the

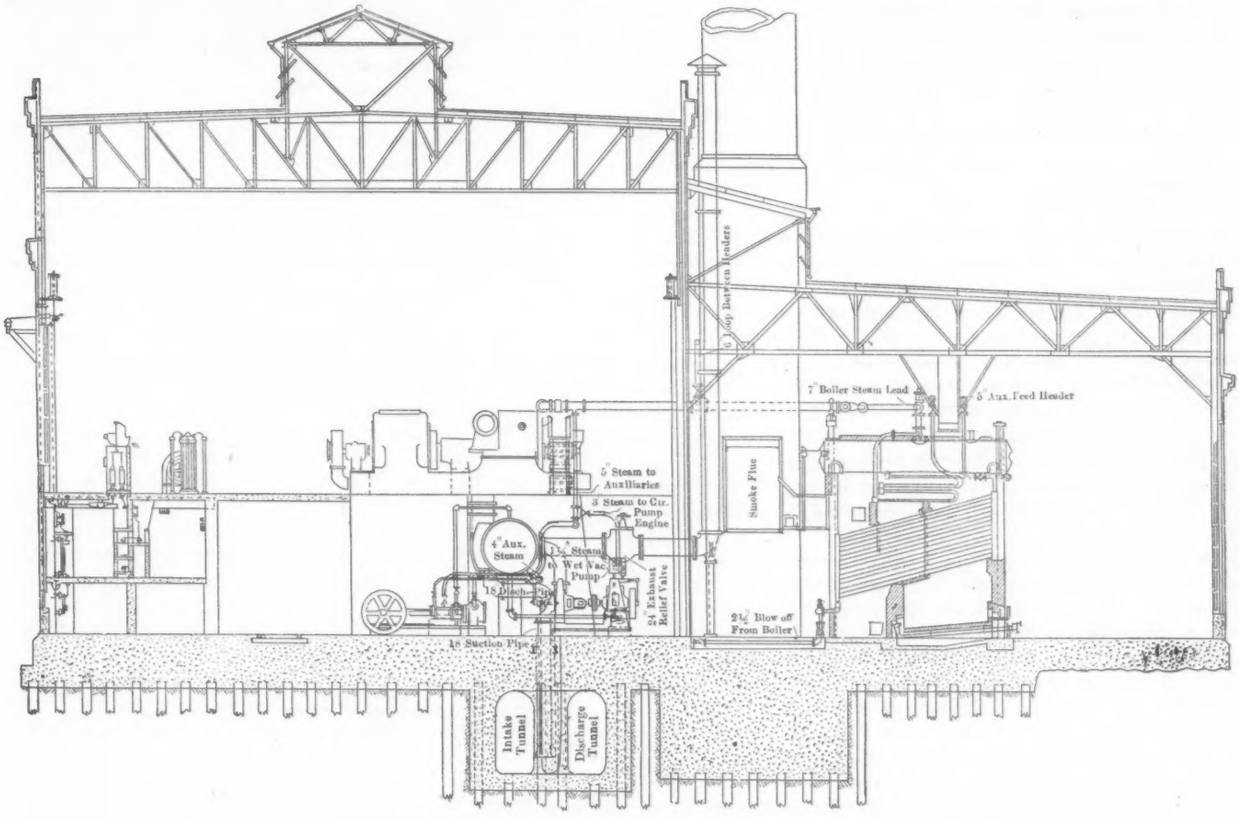


FIG. 2.—CROSS-SECTION OF OAKLAND POWER STATION.

throttle valves on the turbines. The arrangement of the steam piping to auxiliaries is such that all the water of condensation will drain through the cylinders of the boiler-feed pumps, which will do away with the necessity for high-pressure steam traps in the station. The steam supplied to the small oil pumps will be throttled through a reducing valve, cutting the pressure from 210 lb. to 100 lb. The flanges on all live-steam piping are of steel. All flanges 3 in. in diameter and over will be welded to the pipe. All fittings on live steam lines will be annealed steel castings.

The switchboard is of the remote-control benchboard type. The busbars will be located in compartments beneath the oil-switch cells. The switchboard will consist of three generator panels, three exciter panels, one station panel, six feeder panels and one bus-sectionalizing panel. The lightning-arrester equipment will be of the multi-gap type, and will be located beneath the operating floor of the turbine-room. Viele, Blackwell & Buck, of New York, are the engineers in charge of the development of the Great Western power system, Sargent & Lundy, of Chicago, being retained as consulting engineers for the design of the steam-power plant.

White Light from the Mercury Arc and Its Complementary.

By Herbert E. Ives.

ATTEMPTS have been made to modify the color and unpleasant illuminating characteristics of the mercury-vapor arc by the addition of yellower light sources. The first light used for this purpose was that from the carbon-glow lamp. More recently, in an article which appeared since the present investigation was started, the use of a tungsten lamp was described.[1]

In the present paper is recorded an experimental investigation of the proper light source to be combined with the mercury arc in order to imitate average daylight, following which is a determination of the relative intensities of mercury-arc light and the added light to secure the best effect.

In another article,[2] the writer has considered the question of producing white light by screening some of the more common illuminants. The problem of combining lights to produce white can be treated by use of the same data and in a similar manner. As, however, the only case at present occurring of lights suitable for this purpose is that of the mercury arc and its complementary, this was reserved for separate detailed discussion and experimental test.

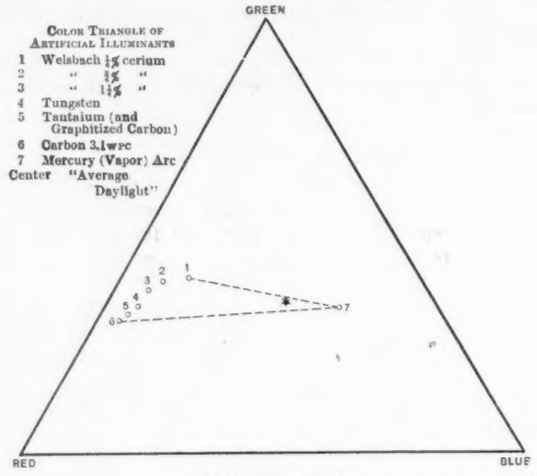
The complementary of the mercury arc may be determined by direct application of color theory to experimentally obtained color values, as, for instance, spectrophotometer data. First, find the spectrum hue of the mercury arc; secondly, find the complementary hue, or hue to be added to produce white; then select a light having that dominant hue. From the color sensation values of the light from the two sources, and the intensity values of the sensations, the candle-power relations of the two to give white are calculable. On carrying through this work the rather unexpected result was obtained that the best combination was that of the mercury arc with a Welsbach gas lamp; unexpected, because the usual criticism of both illuminants is on the ground of their green color, or illuminating effect.

In the present investigation a method similar in principle to the above outlined theoretical discussion was used, differing from it, however, in that it affords an opportunity to make an exact experimental comparison of the combination decided upon with the standard white it is desired to imitate. The Ives colorimeter was employed, together with Maxwell's color triangle.

The Ives colorimeter, designed by Frederic E. Ives, is essentially a color-mixing machine, mixing red, green and blue lights to produce a visual match with the color measured. White being taken as equal parts red, green and blue, other colors are numerically described by the proportionate parts of the three primaries which mix to match them. The lights from various sources have been measured by the writer, among them daylight of various qualities, and the light of the artificial illuminants compare with the average of the daylight measurements as a standard.[3] By means of the light of several of the illuminants which were measured in that investigation it is possible, at any time, to determine the setting of the instrument to give "average daylight," and then compare any artificial white light with it. This possibility made available a verification of the correctness of the work here outlined; had there been no more scientific method of attaining the end, a purely experimental mixing of the light from various sources could have been tried and the best mixture selected. As stated above, use was made of Maxwell's color triangle to guide to the proper selection of complementary to the mercury arc. As the color triangle and its properties are not widely known, a paragraph may be devoted to it.

If the red, green and blue, which, when mixed make white, be represented by the vertices of an equilateral triangle, then all points within the triangle can represent mixtures of red, green and blue in various proportions. Use is made of the property of an equilateral triangle that the sum of the perpendicular distances of any point from the three sides is constant and is equal to the altitude. The red, green and blue representing a color are so expressed that their sum equals the altitude of the triangle, in convenient units. If, then, the vertical distance of a point from the side opposite, say, the red vertex, represents the amount of red, and similarly for green and blue, every color is represented by a point in the triangle. Colors matched by mixing two primaries lie on the sides; white (equal parts of the three primaries) lies at the center. The most important property for the present investigation is this: Mixtures of two colors are represented by points on the line joining the two, therefore two colors which lie on opposite ends of a line through the center are complementary—that is, will mix to produce white.

The illustration shows a color triangle in which the red, green and blue are the primaries of the Ives colorimeter when used



COLOR TRIANGLE.

as described in the paper referred to. The lights from the various sources measured are plotted from the values in the accompanying table, where the values are expressed so that their sum = 100 = altitude of triangle. These figures are from new measurements made for this paper.

COLORIMETER MEASUREMENTS OF THE LIGHTS OF ILLUMINANTS.

	Red.	Green.	Blue.	Candle-power to 1 cp of mercury light.	Specific consumption of combination.
1—Welsbach, ¼ per cent cerium	48.7	38.3	13.0	...	...
2—Welsbach, ¾ per cent cerium	54.0	37.4	8.6	.57	...
3—Welsbach, 1¼ per cent cerium	57.5	35.5	7.0	...	...
4—Tungsten incandescent lamp, 1¼ wpc	61.4	31.7	6.9	.54	0.8 wpc
5—Tantalum incandescent lamp, 2.00 wpc (Similar in color to Gem 2.5 wpc)	64.6	30.4	5.0	...	...
6—Carbon incandescent lamp, 3.1 wpc	65.7	29.8	4.5	.50	1.4 wpc
7—Mercury arc lamp	24.1	31.4	44.5	...	...

An interesting fact brought out by this diagram is that all of the ordinary light sources, from 3.1-watt carbon lamp to the "greenest" Welsbach (¼ per cent cerium), lie so nearly opposite the mercury arc that a respectable white may be produced by mixing any one of them with it in the proper proportion. The light lying most nearly opposite the mercury arc is the Welsbach mantle as supplied for residential lighting, namely with ¾ per cent cerium; of the incandescent electric lamps the tungsten is nearest the ideal complementary.

The results obtained from the diagram were checked experimentally for the three cases considered of most interest—the

[1] A. J. Marshall. *Transactions* of the Illuminating Engineering Society, April, 1909.

[2] *Illuminating Engineer*, August, 1909.

[3] *Transactions* of the Illuminating Engineering Society, November, 1909.

Welsbach, the tungsten and the 3.1-watt carbon lamp. The first two not only come the nearest to the proper hue, but because of their efficiency and cheapness are distinctly practical possibilities. A mercury-vapor lamp was provided with an adjustable cardboard shutter so that more or less mercury light could illuminate the plane of measurement. The Welsbach and the incandescent electric lamps were placed, in succession, directly before the tube and immediately below the opening in the shutter. In this way it was possible to vary the mixing proportions at will. The colorimeter was adjusted by measurements on incandescent electric lamps of known color values, so that one-half its field showed "average daylight," then the shutter over the mercury tube was raised or lowered—the intensity match being preserved by opening or closing the comparison slit of the colorimeter—until the nearest match was found. With the Welsbach and tungsten it was found possible to obtain an extremely close match, the Welsbach match tending slightly toward green and the tungsten toward pink, but by such small amounts that the slight differences of adjustment in several such experiments made simultaneously at one time one and at another time the other mixture appear a perfect match with the standard. The light from the carbon lamp formed, with that of the mercury arc, a decidedly pinkish mixture. The indications of the color triangle were, therefore, borne out.

For practical purposes the important information to be derived from such an experiment is the candle-power relations between the two lights to be mixed. To ascertain these it was necessary to measure the relative intensity of each component illumination as actually obtained on the surface observed during the measurement. The most convenient method was to extinguish each of the two lamps used for a mixture in turn and measure the illumination from the remaining one. As unit of intensity, the green light of the colorimeter was taken; that is, the red and blue slits were closed, the green slit opened until an intensity match was found and the opening of the slit was read. This, of course, involved comparison of two fields of widely different colors. By taking numerous readings and checking the results by the fact that the sum of the two intensities agreed closely with the intensity of the mixture measured in the same way, sufficient accuracy was obtained, it is believed, for the present purpose.

The values found were as follows: To 1 cp from a mercury-arc lamp should be added, to make white, 0.57 cp of Welbach, 0.54 cp of tungsten, 0.50 cp of 3.1-watt carbon. Practically therefore, one may say that to the light from a mercury arc a little over half the candle-power of Welsbach, tungsten or carbon lamp must be added to secure white.

It is interesting to compare these figures with those given by Mr. A. J. Marshall in the installation above referred to. There the proportions were: Mercury vapor, 200 cp; tungsten, 80 cp; a smaller proportion of tungsten than here found best.

Several points in connection with the character of this composite white light should be emphasized. It must not be forgotten that daylight is extremely variable in color and that the combination of lights here investigated can only claim to be a more definite guide than has hitherto been given to the proportions for a match of the integral color to an average daylight. Further, it is, of course, only the integral color that appears white to the eye; analysis reveals the mercury line spectrum superposed on a continuous background strongest in the red. Because of the partly non-continuous character of the spectrum of such compound light, one must expect some deficiencies when it is used as an illuminant of colored objects. The chief defect of the mercury arc alone—its entire deficiency in red—should, however, be largely overcome. Because of the peculiarity of the eye that it quickly adapts its scale of color values to the color of the illuminant, it is much more important, in the writer's opinion, that the illuminant should preserve certain color values to which the eye is sensitive than that its integral color should be a perfect subjective white. In other words, the eye quickly adjusts itself to the belief that a light is "white" even if the light is measurably yellower or pinker than a standard, such as average daylight or sunlight, but rebels at a distortion of its new scale of color values. Therefore, preference should be given to that illuminant of this character which favors preservation of color values to which the eye is particularly sensitive, such as the color of flesh, lips and other commonly observed objects.

The combinations under discussion were investigated for their color-rendering values by observing their effect on various colored silks, plaids, colored prints, flesh, etc. The color values were, on the whole, found to be very well preserved; immeasurably more so than with the mercury arc alone, and much better for blues than with the yellower sources alone. A slight accentuation of purples and a spraying of very deep reds was observable with both combinations—Welsbach and tungsten—but ordinary reds, browns, yellows, greens and blues behaved excellently. The tungsten lamp, with its larger proportion of deep red, is appreciably better in this combination than is the Welsbach, judged by this criterion. For the best results in color rendering, apart from the integral color of the mixture, a larger proportion of the tungsten light, rather than a smaller, might be recommended, because, as remarked above, the resultant pinkish character of the white would be less noticed by the eye than the disturbance of the scale of color values which occurs with a deficiency of continuous spectrum background. The behavior of the carbon lamp is similar to the tungsten, although the integral color is too pink to be called a good white.

The results of the above investigation are as follows: The lights from the Welsbach gas and the tungsten electric lamps are shown to be most nearly complementary in color, of the ordinary illuminants, to the mercury arc; the proportions in which their light should be added to the light of the mercury arc to produce white are determined; study of the color-rendering values of the resultant mixtures indicates that the tungsten combination is the more desirable, and that the proportions given may be considered a lower limit to the amount of tungsten light to be added for satisfactory illumination of colored objects. The incandescent carbon lamp was also investigated and compared with the others in this combination.

An approximate idea of the efficiency of the combination of mercury-arc and incandescent lamps is easily obtained. The power consumption for the tungsten-mercury combination, assuming 1.25 watts per candle for the tungsten and 0.55 watt for the Cooper Hewitt, is 1.22 watts for 1.54 cp, the specific consumption being, therefore, 0.80 watt per candle. For the 3.1-watt carbon-lamp combination the specific consumption is 1.4 watts per candle. Therefore, the tungsten-mercury combination is not only nearer white, but much more efficient than the carbon-lamp combination used at first. A comparison of the Welsbach-mercury combination cannot be made on a specific consumption basis, but consideration of expense causes this combination to compare closely with the mercury-tungsten combination.

Luminosity and Temperature.

By P. G. Nutting.

With light expressed in terms of radiation and radiation a given function of temperature and wave-length, light or luminosity is expressible directly in terms of temperature. These relations of light to radiation and of radiation to temperature have recently received considerable attention. Assuming them to be known, it is well to ascertain what may be done toward establishing the direct relation of luminosity to temperature. The numerical values of some of the constants involved are not known with sufficient precision to permit of very precise numerical deductions, but the general relations developed below show the interrelations of the various quantities involved. The relation of greatest practical interest is that of luminous efficiency to temperature.

Previous work has been limited to portions of the general problem. There are some good experimental determinations of the amount of light (monochromatic and total), but no one appears to have attacked the general problem directly.

Paschen and Wanner[1] in 1899 used a photometric method for determining the second constant of the Wien-Paschen radiation function.

$$J = c_1 \lambda^{-n} e^{-c_2/\lambda T}$$

c_1, c_2 and n being constants, λ wave length and T absolute temperature. Working at constant wave-length they wrote this in the form,

$$\log J = r_1 - \frac{r_2}{T}$$

or for two different temperatures, T_1 and T_2,

$$\log \frac{J_1}{J_2} = r_2\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

r_1 and r_2 being constants. Assuming light proportional to radiation they computed r_2 for four different wave-lengths from their data. The limitations of this assumption will be discussed lated on.

Lummer and Kurlbaum[2] studied the photometric brightness of a hole in a heated opaque envelope as a function of the temperature. They compared the total light with that from a constant source. They expressed their results in the form

$$\frac{H_1}{H_2} = \left(\frac{T_1}{T_2}\right)^x$$

H being brightness, T temperature and x an unknown variable having the following values:

$T =$	900	1000	1100	1200	1400	1600	1900
$x =$	30	25	21	19	18	15	14

They state that x approaches the value 12, but this is not apparent from the plotted curve, and later Rasch showed that their equation was essentially defective, as noted below.

Lummer and Pungsheim[3] then took up the absolute measurement of the total light in hefners emitted by a square mm of a perforation in such an opaque envelope. They found:

Temp.	Hefners per sq. mm.
1175° C	0.0042 H
1325	0.0220
1435	0.0635

and extrapolated

1500° C	0.1 H (about)
1700	0.5
1800	1.0

but did not attempt any theoretical foundation for their results. This work was later greatly extended by Nernst[4] using an iridium furnace cross-checked by an auxiliary heated rod of oxide. He obtained for the light in hefners per square millimeter:

Temp. absolute.	Light.	Temp. absolute.	Light
1464	0.005	2357	4.0
1524	0.01	2446	6.0
1685	0.05	2516	8.0
1764	0.1	2571	10.
1982	0.5	2619	12.
2092	1.0	2680	15.
2217	2.0	2763	20.

His measurements extended to about 2290 abs. The above values were obtained from the relation

$$\log H = B - \frac{A}{T}$$

where H is hefners per square millimeter, T is absolute temperature, $B = 5.367$ and $A = 11{,}230$, the constants being determined from observations between 1400 and 2200. Temperature measurements were made with a Wanner pyrometer, an instrument based on the monochromatic Paschen-Wanner relation mentioned above. His observations then indicate that the monochromatic and total light emission of a complete radiator between 1400 and 2200 differ only by a constant factor.

Rasch[5] appears to have been the first to attempt a rational foundation for the relation of luminosity to temperature. Since retinal action is essentially a chemical process, he reasoned that the thermal equation of chemical equilibrium should apply, the luminous sensation being related to retinal temperature and this again to the rate of absorption of energy. In Van't Hoff's reaction isochore

$$\frac{dK}{K} = -\frac{q}{R}\frac{dT}{T^2}$$

he replaces the equilibrium constant K by brightness H, and the constants $-q/r$ by κ. Hence, by integration,

$$\log H = c - \frac{\kappa}{T}$$

$$\log \frac{H_2}{H_1} = \kappa\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

This indicates that the quantity x in Lummer's equation above is $x = \kappa/T$, and hence is not a constant nor does it approach a constant value. It will be noticed that Rasch's equations are the same in form and but slightly different in interpretation from those of Paschen and Wanner.

Rasch computed a mean value of $\kappa = 26{,}750$ from Lummer and Kurlbaum's data. Lucas,[6] from the relation $\kappa = c_2/\lambda$ and c_2 (the second constant of the Wien-Paschen equation) $= 14{,}500$, finds for λ the value 0.542μ, an equivalent mean wave-length in dealing with total light.

Goldhammer,[7] from the data of König on visual sensibility, and the work of Rasch just mentioned, derived the function,

$$V = \left(\frac{\lambda_o}{\lambda} e^{1 - \frac{\lambda_o}{\lambda}}\right)^m$$

to represent the ratio of light to radiation at each wave-length, λ_0 being the wave-length of maximum sensibility and m a constant varying from 150 to 300 for different individuals. Both λ_0 and m are found to vary somewhat with the intensity of the radiation. Goldhammer recognized that it was necessary to introduce this auxiliary function visibility of radiation (V) to convert radiation into light. He multiplied the above function V by the Wien-Paschen function $J = c_1\lambda^{-5}e^{-c_2/\lambda T}$ and thus obtained for the total light from a complete radiator

$$H = a\left(\frac{T}{T+b}\right)^n$$

a, b and n being constants. He did not attempt to construct a visibility function to represent the average human eye. The one he did construct contains the large exponent m, and is always steeper on the blue side of the maximum, while the experimental curves are steeper on either side in about equal numbers. It differs only in its constants from the Wien-Paschen function for non-selective radiation.

The writer[8] has developed a visibility function of the form

$$V = V_o e^{-\kappa(\lambda - \lambda_m)^2}$$

to represent the sensibility of the average human eye. Here V_o is a constant depending upon the units employed, κ is 4.6 at low intensities (<0.05 meter-candle) and 2.0 at high (>10 meter-candle), while λ_m, the wave-length of maximum sensibility, is similarly 0.511μ at low intensities (rod vision) and 0.565μ at high (cone vision).

If the light is expressed in meter-candles and the radiation in meter-watts per unit wave-length, then V_o is the number of candles per watt at the wave-length of maximum sensibility, $\lambda = \lambda_m$, for here $L = EV$ becomes $L = EV_o$. To find this ratio of light to radiation it is only necessary to measure the same monochromatic radiation as light and as power. This ratio the author found to be 13.5 candles per watt, while Drysdale[9] found 16.7. König's data on visual sensibility indicates that this ratio is a constant except for intensities ranging from about 0.3 meter-candle up to 30 meter-candles, which is the range during which the transition from rod to cone vision occurs.

Visibility then is the constant of proportionality between radiation and light. It varies enormously with the wave-length, but at constant wave-length is constant at very high and very low intensities with an uncertainty slightly larger than the pos-

[1] *Sitz*, Berlin, Ak. 2, 5-11; 1899.
[2] *Verh. Ph. Ges.*, 2, 89-90; 1900.
[3] *Ph. Zeit.*, 3, 97-100; 1901.
[4] *Ph. Zeit.*, 7, 380-383; June 1, 1906.
[5] *Ann. Physik*, 14, 193-203; May, 1904.
[6] *Ph. Zeit.*, 6, 19-20; Jan. 1, 1906.
[7] *Ann. Physik*, 16, 621-652; April, 1905.
[8] *The Electrical World*, June 27, 1909. *Bulletin*, Bureau of Standards, Vol. 5, 261-305; 1908.
[9] *Proc.* Royal Society, 80, 19-25; 1907.

sible curve in its determination through a small range of moderate intensities. By light is here meant not visual sensation, but photometric brightness, something that is constant when the sensation is constant, the quantity dealt with in ordinary photometry.

The visibility function may now be applied to known types of radiation. The best known is the non-selective radiation from the interior of a nearly closed cavity having opaque walls. This is known to be related to wave-length and the temperature of the radiator by the Planck function.

$$E_\lambda = \frac{c_1\lambda^{-n}}{e^{c_2/\lambda T}-1}$$

This is difficult to handle, but if it is expanded in a power series, the first term is the Wien-Paschen function

$$E_\lambda = c_1\lambda^{-n}e^{-c_2/\lambda T} \qquad (1)$$

which is sufficiently accurate in dealing with the short wave-lengths of the visible spectrum. Multiplying this by the visibility function,

$$V = V_0 e^{-\kappa(\lambda-\lambda_m)^2} \qquad (2)$$

the product is the desired relation between luminosity and temperature.

$$L = EV = C_1V_0\lambda^{-n}e^{-c_2/\lambda T-\kappa(\lambda-\lambda_m)^2} \qquad (3)$$

Hence the isochromatic relation (λ constant) is of the form

$$\log L = A - B/T, \qquad (4)$$

where

$$A = \log(C_1V_0\lambda^{-n}) - \kappa(\lambda-\lambda_m)^2,$$

and

$$B = C_2/\lambda.$$

The value of the constant B is seen to be independent of the form of the visibility function, while the constant A is not. Moreover, the form of (4) does not in any way depend upon the form of the visibility function, but only upon the form of the emission function, $E(\lambda_1 T)$.

From (4) may be deduced the relative temperatures at which the various spectral colors appear. For $L=1$, the temperatures at which complete radiators will attain a specific luminosity of one light unit (the threshold value in this case) per unit wave-length will be given by

$$T_0 = \frac{B}{A} = \frac{c_2/\lambda}{\log(C_1V_0\lambda^{-n}) - \kappa(\lambda-\lambda_m)^2}$$

from which T_0 may be calculated for each wave-length.

Equation (4) assumes a constant wave-length, hence it can apply only to a limited spectral region at a time. The reason that it has been found (by Nernst and others) experimentally to hold approximately for total light emission is that for a complete radiator 90 per cent of the light is confined to a spectral region only 0.1 μ broad, because of the narrow form of the visibility curve. The fact that both κ and λ_m vary considerably with intensity is of no consequence so long as the product $\kappa(\lambda-\lambda_m)^2$ remains constant.

The relation between total light emission and temperature is obtained by integrating $EVd\lambda$ from zero to infinity. In the form (3) above it is not readily integrable, but using the alternative form[10] of visibility function,

$$V = V_0\left(\frac{\lambda_m}{\lambda}\right)^\gamma e^\gamma\left(1-\frac{\lambda_m}{\lambda}\right) \qquad (5)$$

the product, EV, may be easily integrated in the form

$$L = \int_0^\infty EVd\lambda = C_1V_0\lambda_m{}^\gamma e^\gamma\Gamma(n+\gamma-1)\left(\frac{c_2}{T}+\gamma\lambda_m\right)^{-(n+\gamma-1)} \qquad (6)$$

which is of the simple form

$$L = A\left(\frac{B}{T}+1\right)^{-p} \qquad (7)$$

where

$$A = C_1V_0\lambda_m{}^\gamma e^\gamma\Gamma(n+\gamma-1)(\gamma\lambda_m)^{-p} = C_1V_0\left(\frac{B}{c_2}\right)^{n-1}\sqrt{2n\gamma}\,\frac{\Gamma(n+\gamma-1)}{\Gamma(\gamma+1)}$$

$$B = c_2/\gamma\lambda_m.$$

$$p = n+\gamma-1$$

[10] *Bulletin*, Bureau of Standards, Vol. 5, p. 277.

This expression for the light emitted applies to any body whose radiation is expressible by equation (1) viewed by any eye whose chromatic sensibility may be represented by equation (5); that is, it is of general application to incandescent elementary solids.

Defining luminous efficiency F as the ratio of the total light emitted to the total power radiated from the same area, from (1) and (7),

$$F = \int_0^\infty EVd\lambda : \int_0^\infty Ed\lambda = A\left(\frac{B}{T}+1\right)^{-p} : aT^{n-3} \qquad (8)$$

Since

$$\int_0^\infty Ed\lambda = c_1\left(\frac{T}{c_2}\right)^{n-1}\Gamma(n-1) = aT^{n-1}.$$

Equation (8) may be reduced to

$$F = V_0\sqrt{2\pi\gamma}B^{n-1}\frac{\Gamma(n+\gamma-1)}{\Gamma(\gamma+1)\Gamma(n-1)}\,\frac{T^\gamma}{(B+T)^{n+\gamma-1}}$$

by means of the relation

$$\Gamma(x+1) = x^x e^{-x}\sqrt{2\pi x}\left(1+\frac{1}{12x}+\frac{1}{288x^2}+\cdots\right)$$

a form more convenient for computation.

Since γ is greater than 100, the series in parentheses has the value unity to within 0.001. The luminous efficiency has a maximum value

$$F_m = V_0\left(\frac{n-1}{n+\gamma-1}\right)^{1/2} \qquad (9)$$

at a temperature

$$T_m = B\,\frac{\gamma}{n-1} = \frac{C_2}{(n-1)\lambda_m} \qquad (10)$$

The numerical values of all the constants in (6) and (8) have been determined, but in no case with great precision. From König's data on visual sensibility,[11] γ may be calculated to be 120 ± 10, a pure number with an uncertainty of about 10 units. The wave-length of maximum visual sensibility is $0.565\pm0.005\mu$. General average values of γ and λ_m for a large number of individuals might lie outside even those limits of uncertainty, but it is hardly probable. The values here quoted apply to cone vision. For low intensities (rod vision) γ is about 300, while $\lambda_m = 0.511\mu$, but the value of V_0 has not been determined, so that one is unable, at present, to compute the luminosity of very faint sources and weak reflected light.

For enclosed radiators of the "black-body" type $C_2 = 14{,}500 \pm 300$ when wave-lengths are in microns (μ) and temperatures in Centigrade degrees absolute, $n=5$, an integer, so far as known. For other bodies n varies from 5.5 to 7. Coblentz[12] for an untreated carbon filament found n to be from 5.2 to 6.5 (decreasing with increase in temperatures), for platinum $n=6$ to 8, "metallized" carbon $n=5.8$ to 6.0, silicon carbide $n=6.4$. For lamps run at normal voltage, he found for:

"Metallized"	carbon	$n=6.1$
Tantalum		$n=6.3$
Tungsten		$n=6.6$
Osmium		$n=6.9$

For radiation from a cavity or "black body," then, the temperature of maximum luminous efficiency is

$$T_m = \frac{14{,}500}{(5-1)\times0.565} = 6420 \text{ deg.} \pm 200 \text{ deg. abs.}$$

the value of the corresponding specific output in candles per watt being

$$F_m = 15\left(\frac{5-1}{5+120-1}\right)^{1/2} = 2.7\pm0.2.$$

The value of $V_0 = 15.0$ is the mean of the values of Drysdale (16.5) and the author (13.5), and the uncertainty in the result

[11] *Bulletin*, Bureau of Standards, Vol. 5, p. 279.

[12] *Bulletin*, Bureau of Standards, Vol. 5, p. 339.

is due chiefly to the uncertainty in this value. This result indicates that such a radiator could give at best (6420 deg.) only about 18 per cent as much light as it would if all its radiation were confined to yellow-green.

At a temperature of 2000 deg. abs. (1727 deg. C.) the computed luminous efficiency is

$T = 2000°$ abs. $\quad C_2 = 14{,}500 \quad \gamma = 120 \quad V_0 = 15.0$

$n =$	5.0	6.0	7.0
Spec. output.....	.055	2.09	5.05

The first case ($n = 5$) corresponds to a perfect radiator or black body. This table is made on the assumption of C_2 constant. Very little is known as to its variation with temperature and with the substance radiating. Lummer and Pringsheim's results indicate that for a given substance C_2 varies in proportion to n, so that

$$\lambda_{max} T = C_2/n = \text{constant}$$

and they give for platinum $C_2 = 15{,}600$. For platinum then at 2000 deg. abs. = 1727 deg. C., just below the melting point, the specific output is 0.121 candle per watt.

The variation of luminous efficiency with temperature

$$\frac{\delta F}{\delta T} = F\left(\frac{\gamma}{T} - \frac{n+\gamma-1}{B+T}\right)$$

is not very rapid at high temperatures, so that (8) could hardly be applied to advantage to the measurement of temperatures nor could it be applied to the determination of the visual constant γ. The variation of F in candles per watt with γ is for

$n = 5$, $T = 2000$ deg. abs., $V = 15.0$

$V =$	120.	110.	100.
$F =$	.051	.058	.062

Its most useful field appears to be in the determination of C_2, with which F varies rapidly

The agreement of the above-calculated efficiencies with observed values are sufficiently close to give formula (8) considerable weight. The rapid increase in computed efficiency with the constant n, shown above, is quite in accord with experience with the new incandescent electric lamps and Coblentz values of this constant for such lamps.

Design of Illuminating Installations Using Luminous Tubes.

By M. D. Cooper.

IT is of importance to the illuminating engineer to be able to predetermine with a considerable degree of accuracy the amount and distribution of the illumination produced by a given system of lamps. In the case of concentrated light sources, such as arc, incandescent and gas lamps, the methods of predetermination are well known. Given the polar candle-power distribution curve of the lamp, the illumination produced at a point on the reference plane can be determined as the candle-power in the direction of the point divided by the square of the distance to the point and multiplied by the cosine of the angle of incidence of the ray of light on the reference plane.

The above method of calculation assumes the validity of the two fundamental laws of photometry, namely, the inverse square law, which states that the illumination produced by a point source is inversely proportional to the square of the distance from the source; and Lambert's cosine law, which states that the intensity of radiation from a radiating surface varies as the cosine of the angle of emission. The truth of the first law is self-evident if the rectilinear propagation of light is assumed. Lambert's cosine law was deduced from the observation that a uniformly bright sphere, when viewed at a distance, appears to be a uniformly bright disk. This law is applicable only to small elements of a surface. Lambert's law of intensity of radiation from a surface applies with the same restriction to the illumination of a surface by incident light. Hence, in the above method of computing illumination, the cosine law holds, for it is only an element of the reference plane that is under consideration. The error introduced by the use of the inverse square law can usually be neglected, for experiment proves that when the distance from a lamp is greater than 10 times the maximum dimension of the light source, the actual illumination always differs by less than 2 per cent from that computed by the inverse square method.

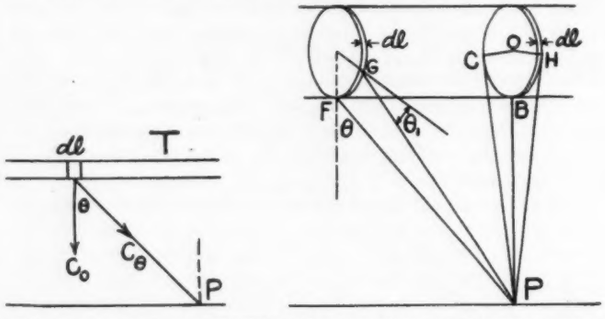
It becomes evident, therefore, that the ordinary method of illumination calculation cannot be applied to distributed light sources, such as Moore tubes and long mercury-vapor lamps. In the present article there will be derived a method of calculation which can be applied to such illuminants.

In Fig. 1 let T represent a section of a luminous tube and P be a point at which it is desired to find the illumination. If the candle-power of the element dl in the direction $dl - P$ is known it will be a simple matter to write an expression for the illumination produced at P by the element dl. Integration over the length of the tube would then give the total illumination at the point P.

THEORETICAL CONSIDERATIONS.

At first glance it would appear that the cosine law could be applied to the cylindrical element, or that $C_\theta = C_0 \cos \Theta$, C_θ being the candle-power in the direction $dl - P$, and C_0 the normal candle-power of the cylindrical element.

The assumption of the cosine law would be warranted if the tube could be considered equivalent to a flat radiating strip of



FIGS. 1 AND 2.—DETERMINING ILLUMINATION AT A GIVEN POINT.

a width equal in diameter of the tube, but the curvature of the tube surface tends to make such an assumption inaccurate.

If, however, the tube is considered as a solid radiating cylinder, the relations are more involved. Inspection of Fig. 2 will show what results can be anticipated in this case. To calculate the normal candle-power of an element dl at B, a summation would be made of the luminous intensities in the direction of P of elementary areas of the strip dl. As the summation would be carried over only the arc HBC, the computed normal candle-power, C_0, would be less than when considering the tube equivalent to a flat strip. For an element dl at F, C_θ will be less than $C_0 \cos \Theta$, because at all points other than F, Θ_1 will be greater than Θ. This consideration leads to the conclusion that C_θ, Fig. 1, will be somewhat less than $C_0 \cos \Theta$.

The tube is not, however, a solid radiating body, but gives light by the luminosity of a gas, hence consideration on this latter basis will lead to more correct conclusions. Experiment proves that an open gas flame gives nearly the same candle-power in all horizontal directions, indicating that the luminous intensity of a radiating gas depends primarily on the number of luminous particles contributing light, and only in a very secondary degree upon the alignment of these particles. This fact would seem to indicate that the intermolecular spaces are so great compared to the size of the molecules that there is practically no interference with free radiation from each and every molecule.

This line of reasoning affords another method of ascertaining C_θ. The candle-power along any line can be assumed to be proportional to the length of this line inside the tube. Refraction need not be considered, as the rays of light will suffer merely a slight lateral displacement and will not be changed in direction on passing the walls of the tube. With these facts

in mind, inspection of Fig. 2 will now show that C_θ will be at least equal to $C_o \cos \Theta$, if not actually greater.

Assuming, as a fair approximation, that the cosine law can be applied, the integration for the total illumination at P, Fig. 1, will be performed.

APPLICATION OF COSINE LAW.

Let Fig. 3 represent a length of tube and P be the point at which it is desired to determine the illumination. Furthermore, let

C = total candle-power of tube, interpreted physically as the candle-power measured at an infinite distance.
L = length of tube, in feet.
h = height above reference plane, in feet.
s = slant distance from P to tube, in feet.
l = distance (parallel to tube) from P to element dl.
ω = angle between ray P-dl and normal to reference plane.
Θ = angle between ray P-dl and normal to tube.
ϕ = angle subtended at P by the tube.
β = angle between s and h.

Assuming the cosine relation, $C_\theta = C_o \cos \Theta$, to be correct

$$C_o = \frac{C}{L}\, dl$$

$$C_\theta = \frac{C}{L}\, dl \cos \Theta$$

The element dl of the tube will contribute to the illumination at P an element

$$dY = \left(\frac{C}{L} dl \cos \Theta\right)\left(\frac{1}{z^2}\right)(\cos \omega)$$
$$= \frac{C}{L}\, dl\, \frac{s}{z}\frac{1}{z^2}\frac{h}{z}$$
$$= \frac{C}{L}\, \frac{sh}{z^4}\, dl$$

Noting that $z = \sqrt{s^2 + l^2}$, the illumination at P due to the part l_1 of the tube becomes

$$Y_1 = \frac{Csh}{L}\int_o^{l_1} \frac{dl}{(s^2+l^2)^2}$$
$$= \frac{Csh}{L}\left[\frac{l}{2s^2(s^2+l^2)} + \frac{1}{2s^3}\tan^{-1}\frac{l}{s}\right]_o$$
$$= \frac{Ch}{2Ls^2}\left[\frac{sl_1}{s^2+l_1^2} + \phi_1\right]$$

Putting l_2 for l_1 there would result Y_2 due to the part l_2 of the tube, whence addition gives the total illumination at P as

$$Y = \frac{Ch}{2Ls^2}\left[\phi_1 + \phi_2 + \frac{sl_1}{s^2+l_1^2} + \frac{sl_2}{s^2+l_2^2}\right]$$
$$= \frac{Ch}{2Ls^2}\left[\phi + \frac{s}{L}\left[\frac{\frac{l_1}{L}}{\left[\frac{s}{L}\right]^2+\left[\frac{l_1}{L}\right]^2} + \frac{\frac{l_2}{L}}{\left[\frac{s}{L}\right]^2+\left[\frac{l_2}{L}\right]^2}\right]\right]$$

Let $m = \frac{s}{L}$, the ratio of the slant height from P to the total length of the tube, and let $p = \frac{l_1}{L}$, the fractional distance from the end of the tube. It will be well at this point to emphasize the significance of these two ratios, as they appear throughout all the later work and furnish a key to its complete understanding. Substituting in these ratios,

$$Y = \frac{Ch}{2Ls^2}\left[\phi + m\left(\frac{p}{p^2+m^2} - \frac{1-p}{(1-p)^2+m^2}\right)\right] \qquad (1)$$

Then

$$Y = \frac{Ch}{2Ls^2}K = \frac{C}{2L}\frac{h}{s^2}K \qquad (2)$$

in which expression the constant K depends for its value only on the relative, rather than the actual, dimensions of the tube installation. $\frac{C}{2L}$ is half of the candle-power per foot, $\frac{h}{s^2}$ is constant for any line on the reference plane parallel to the tube, and K varies for different positions along such a line.

It becomes then a simple matter to explore the reference plane in investigating the illumination produced by the tube. A line can be taken parallel to the tube, $\frac{C}{2L}\cdot\frac{h}{s^2}$ determined for this line, and values of K can be obtained from Fig. 4 for points along the line; multiplication of these two quantities will give the value of the illumination at the points selected. The curves of Fig. 4 are plotted from data computed from equation 1. Different values of m were assumed, ϕ was ascertained from a graphical construction, and the remainder of the expression for K was computed by slide rule. As K is the

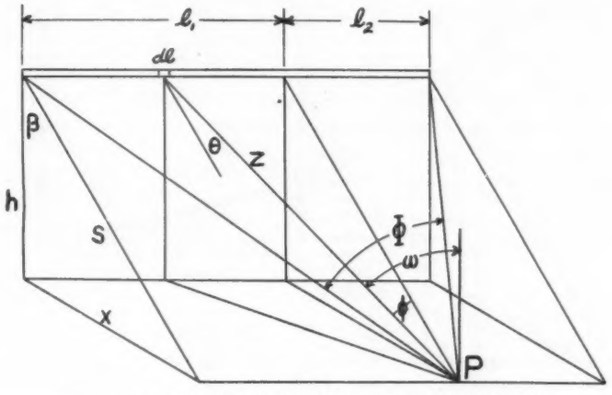


FIG. 3.—SPACE DIAGRAM OF ILLUMINATION RELATIONS.

only variable in equation (2) when a line parallel to the tube is under consideration, the curves of Fig. 4 show the variation of illumination along such a line. The curves of Fig. 5 are derived from those of Fig. 4, p being the variable parameter instead of m. With the two sets of curves, double interpolation is made possible, and K can be determined for any and all values of p and m. In order to facilitate extended computations, values of the expression $\frac{h}{s^2}$ may be derived for various heights of tube h and various distances x out from a line directly underneath the tube. These values can be arranged for reference in the form of a table.

It is interesting to consider the case of the illumination on

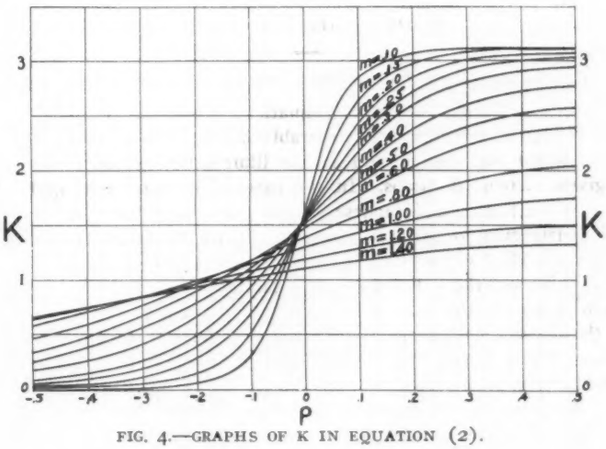


FIG. 4.—GRAPHS OF K IN EQUATION (2).

the line directly beneath the tube. For this condition $s = h$, and equation 1 becomes

$$Y = \frac{C}{2Lh}\left[\phi + m\left(\frac{p}{p^2+m^2} + \frac{1-p}{(1-p)^2+m^2}\right)\right] \qquad (3)$$

Apparently the general formula (1) can be derived from the above by multiplication by $\frac{h^2}{s^2}$, or $\cos^2 \beta$. As the point P moves out from a position directly underneath the tube, however, m and ϕ change and the corresponding curve of K becomes of lower value (beneath the tube; perhaps higher beyond the tube ends), and more nearly horizontal. Thus, by

moving out from positions beneath the tube the illumination is decreased somewhat more than by the multiplier $\cos^2 \beta$.

PHOTOMETRY OF TUBULAR LAMPS.

In order to apply formula (1) it is necessary to know the candle-power per foot of the tube to be considered. To determine this quantity experimentally the tube might be covered with black cloth or paper, leaving exposed a length of a

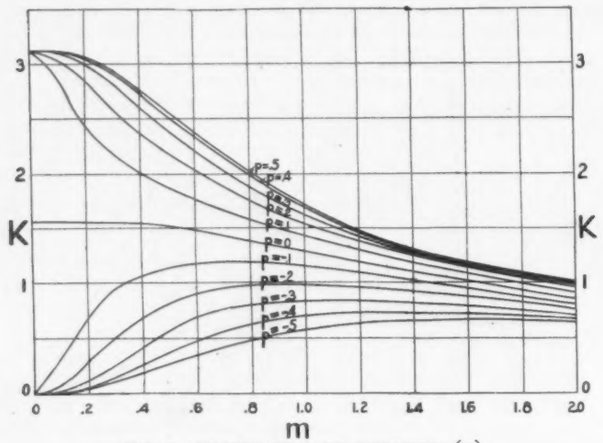


FIG. 5.—VALUES OF K IN EQUATION (2).

foot, say. Any ordinary photometer could then be used to determine the candle-power of the exposed section.

If the tube is at right angles to the photometer bar, p in equation (3) becomes 0.5 and the equation reduces to

$$Y_a = \frac{C}{2Lh}\left[\phi + m\left(\frac{1}{m^2+.25}\right)\right]$$

$$= \frac{C}{2Lh}\left[2\tan^{-1}\frac{L}{2h} + \frac{h}{L}\left(\frac{1}{m^2+.25}\right)\right] \qquad (4)$$

the subscript a under Y signifying that the actual illumination produced is meant.

Applying the inverse-square law to the same case, the theoretical illumination, Y_t, at distance h is given by the expression

$$Y_t = \frac{C}{h^2} \qquad (5)$$

For equation (5) to hold it is necessary that all the light

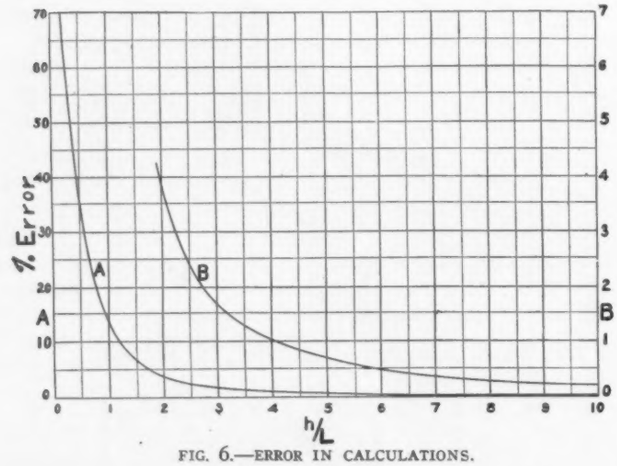


FIG. 6.—ERROR IN CALCULATIONS.

strike the photometer normally, but since with a tube source this condition is not realized, it is evident that Y_a will be less than Y_t. The percentage error in Y_t— that is, the percentage by which Y_t must be decreased to give Y_a—is

$$\text{Percentage error} = 100\,\frac{Y_t - Y_a}{Y_t} \qquad (6)$$

Fig. 6 shows the values of this percentage error for various values of $\frac{h}{L}$. A practical application of this curve would be its use in the derivation of a correction factor to be applied to candle-power measurements of tube sources. The candle-power could be determined in the ordinary manner by the application of the inverse-square relation, then multiplication by the correction factor would reduce the erroneous result to the right one.

In the equation of the photometer, $C = C'\frac{h^2}{h'^2}$, $\frac{C'}{h'^2}$ is the illumination of the photometer screen produced by the comparison standard, which at a balance is the same as the illumination produced by the unknown source. With the same notation as before, $\frac{C'}{h'^2}$ is Y_t, the subscript meaning that the inverse-square relation has been assumed, then the equation for C above could be written $C = Y_t h^2$. An illumination Y_t would not be produced on the screen by a tubular source of candle-power C at a distance h, for it has been shown that Y_a is less than Y_t. In order to make the above equation usable for computation it will be necessary to introduce a factor changing Y_t to Y_a.

Now from equation (6), letting e represent the error (decimal, not per cent)

$$e = \frac{Y_t - Y_a}{Y_t}, \text{ or } Y_t = \frac{Y_a}{1-e}, \text{ and substituting above}$$

$$C_a = \frac{Y_a}{1-e}h^2$$

As $\frac{C_a}{h^2}$ gives Y_t, the erroneous illumination computed on the assumption of the inverse-square relation, so $Y_a h^2$ gives C_t,

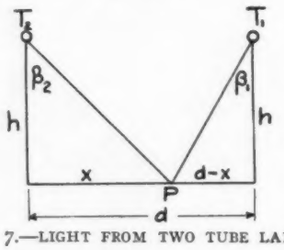


FIG. 7.—LIGHT FROM TWO TUBE LAMPS.

the erroneous candle-power computed on the same assumption. Thus, substituting C_t for $Y_a h^2$, there results

$$C_a = \frac{C_t}{1-e} \qquad (7)$$

In other words, the candle-power computed by the inverse-square method will, when divided by $(1-e)$, give the actual candle-power.

CONDITIONS FOR UNIFORM ILLUMINATION.

It was shown above that, aside from the variation of K, the illumination at any point, as the point moves out from beneath the tube, varies as $\cos^2 \beta$, where β is the angle between the slant line from the point to the tube and the normal to the reference plane. If the length of a tube is large compared to its height above the reference plane (m being, therefore, small), and only points near the center of the tube are considered, K will remain nearly constant. If, then, in Fig. 7 T_1 and T_2 are two similar tubes spaced a distance d apart, and Y_o denotes the illumination produced by one tube directly beneath its center, it can be written that

$$Y_p = Y_o \cos^2 \beta_1 + Y_o \cos^2 \beta_2.$$

Dividing by Y_o,

$$\frac{Y_p}{Y_o} = \cos^2 \beta_1 + \cos^2 \beta_2$$

$$= \frac{h^2}{h^2+x^2} + \frac{h^2}{h^2+(d-x)^2}$$

$$= \frac{1}{1+\left[\frac{x}{h}\right]^2} + \frac{1}{1+\left[\frac{d}{h}-\frac{x}{h}\right]^2} \qquad (8)$$

If now a value of $d \div h$ can be found that will give a constant value of $Y_p \div Y_o$ for all values of $x \div h$, the problem of so spacing the tubes as to secure uniform illumination is solved. The exact solution for this condition by calculus is rather complicated, hence a solution by trial will be given. The accompanying table shows what variation in resultant illumination is encountered when $d \div h$ is 2, 1.5 and 1.0. This table shows that when $d = 2h$ the illumination half-way between the two tubes is only 83.3 per cent of that directly beneath a tube; when $d = 1.5h$ there is a variation of 2 per cent above and below the mean; and when $d = h$ there is an increase of 6.7 per cent. It is seen that with a separation of tubes of 1.5 times their height above the reference plane the most uniform illumination is secured, and also that under this condition the average illumination between tubes is about 1.3 times that produced by one tube directly beneath its center.

VARIATION IN RESULTANT ILLUMINATION.

$d \div h = 2$			$d \div h = 1.5$			$d \div h = 1.0$		
$x \div h$	$Y_p \div I_o$	Per cent	$x \div h$	$Y_p \div Y_o$	Per cent	$x \div h$	$Y_p \div Y_o$	Per cent
.0	1.200	100.0	.0	1.308	100.0	.0	1.500	100.0
.2	1.198	99.8	.2	1.333	102.0	.1	1.553	103.5
.4	1.143	95.3	.4	1.315	100.5	.2	1.572	104.7
.6	1.073	89.8	.6	1.288	98.5	.3	1.589	105.9
.8	1.020	85.0	.75	1.282	98.1	.4	1.597	106.4
1.0	1.000	83.3	..	....	....	.5	1.600	106.7

METHOD OF DESIGN.

The conclusions of the preceding paragraph lead to a very simple method of designing installations of lighting tubes. In most cases the room to be illuminated will be rectangular in shape, so that the parts of the installation which are hung along the length of the room will contribute most of the required illumination. The correct placing of the tubes on the longer sides of the room is then the main point to consider.

The side tubes must be near enough to the sides of the room to give a reasonable illumination at the edges of the reference plane. If the distance from the tube to the wall is from one-quarter to one-third of the distance between tubes, this condition will generally be amply fulfilled. Approximating, then, the distance apart the tubes are to be spaced, the condition for uniform illumination is that the height shall equal the spacing divided by from 1.5 to 1.2, the former being the preferable divisor. Spaced in this manner, the average illumination will be very nearly 1.3 times that given by one tube alone; hence, dividing 1.3 into the required foot-candles of illumination will give that required of one tube beneath its center. Substitution in equation (2) will give the candle-power per foot required of the tube to furnish this illumination, and the voltage of supply can be adjusted to give the necessary candle-power. The luminosity of a tube lamp can be varied from nothing to 30 cp per foot by changing the applied voltage, hence adjustment over a wide range is possible. For best operating conditions, the luminosity should be about 10 cp per foot. Other luminosities are obtained at a slight sacrifice of efficiency.

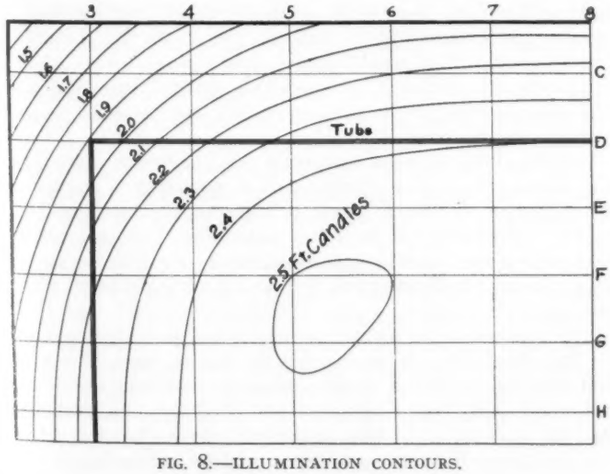


FIG. 8.—ILLUMINATION CONTOURS.

TRIAL INSTALLATION.

Specifications.

Room, 35 ft. x 25 ft.; 2 foot-candles illumination required on reference plane 2.5 ft. above the floor.

Calculations.

$2 \div 1.3 = 1.54$ foot-candles required of one tube.

The first trial spacing will be 15 ft. Height of tubes above reference plane $= 15/1.5 = 10$ ft. Under the center of the tube

$$I_o = \frac{C}{L}\frac{K}{2h}$$

Let $L = 30$, $h = 10$, then $m = 0.33$ and at $p = 0.5$, $K = 2.88$

$$1.54 = \frac{C}{L}\frac{2.88}{2 \times 10} \text{ or } \frac{C}{L} = 10.7,$$ a satisfactory value.

With this spacing the necessary candle-power per foot proves satisfactory, but the tubes will be 5 ft. from the edges of the room, and the illumination there might prove insufficient. Accordingly, the spacing will be increased to 18 ft. This value will leave only 3.5 ft. between the side tubes and the wall, and will undoubtedly prove more effective. Leaving the length unchanged, $L = 30$ ft., $h = 12$ ft., $m = 0.4$, and at $p = 0.5$, $K = 2.77$,

$$1.54 = \frac{C}{L}\frac{2.77}{2 \times 12}, \text{ or } \frac{C}{L} = 13.35,$$ which is higher than customary, but easily securable.

An exploration of the reference plane may now be made on lines perpendicular to the tubes. For assigned values of x, s is obtained from the equation $s = \sqrt{h^2 + x^2}$. The value of $\frac{h}{s^2}$ is computed and multiplied by $C \div 2L = \frac{13.35}{2}$ for use in formula No. (2). The value of K is read from Fig. 5 for various values of P, whence $Y = K\frac{6.67h}{s^2}$ gives the foot-candle illumination. A similar calculation may be made for the same points on lines perpendicular to the end tubes, whence addition of the illuminations produced at a point by the tubes on the four sides of the room will give values from which illumination contours can be plotted, as shown in Fig. 8. It is necessary to consider only one-quarter of the room, because the illumination at symmetrical points is the same. The lower right-hand corner in Fig. 8 represents the center of the room.

Inspection of Fig. 8 will show that the tube system of lighting can be designed to yield excellent results as regards the uniformity of illumination. In the case of this trial installation the results are better than the contour plat shows, because multiple reflection from the walls and ceiling will increase the illumination at the edges of the room more than in the middle; furthermore, near the ends of the tube, or beyond, there is actually more illumination than is computed on the assumption of the validity of the cosine law.

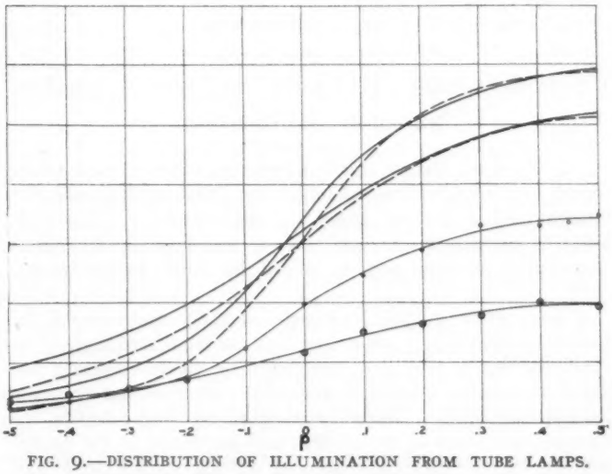


FIG. 9.—DISTRIBUTION OF ILLUMINATION FROM TUBE LAMPS.

EXPERIMENTAL VERIFICATION OF RESULTS.

In investigating the subject of radiation from tubes at the University of Wisconsin, the author secured some curves show-

ing the distribution of illumination along a short tube, and these curves serve as an admirable verification of the results deduced above. The tube used was 10 ft. long, and curves were taken with it mounted parallel to a photometer track, on the carriage of which was placed a Sharp-Millar illuminometer. By balancing this illuminometer at various points along the track, data were obtained for the lower curves of Fig. 9. The ordinates of these curves, multiplied by the constant of the instrument as used, would give the actual illumination at various points; but, as drawn, show only the *distribution* of illumination along the tube. The curves of Fig. 4, derived on the assumption of the cosine law, also show the distribution of illumination along the tube; hence, an agreement in shape between the two lower curves of Fig. 9 and the curves of Fig. 4 having the same values of m will show that the cosine law is applicable to the case in hand. The effective length of the tube used was 250 cm, and the distances to the reference plane were 75 cm and 125 cm, hence the values of m for the two lower curves of Fig. 9 are 0.3 and 0.5, respectively. The dotted curves are copied from Fig. 4 for the above values of m. To test for similarity of shape the ordinates of the lower curves were increased proportionately till they coincided at $p = 0.4$, the result being the upper full lines of Fig. 9.

The curves show that under the tube—that is, over the range from $p = 0.5$ to $p = 0.0$—the cosine law is verified almost exactly, and that beyond the tube ends (for negative values of p) the actual illumination is greater than computed on the assumption of the cosine law. This relation would have the effect of improving the uniformity of illumination produced by an installation of the tube, as mentioned in connection with the design of the trial installation.

The very good verification of the cosine law shows that entire dependence can be placed on the method of illumination design derived and outlined above. The divergence of the checking curves for negative values of p shows that the computed illumination near the edges of a room may be in error, but as the actual value will be greater than the computed, the error will be on the safe side.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Producer Gas Plant at St. Joseph, Mich.

The street lighting of St. Joseph, Mich., for the past four years has been operated from a producer-gas engine located at the municipal water works. The engine is a three-cylinder Nash of 115 hp. It is supplied with producer gas by an R. D. Wood & Company suction producer, which uses anthracite coal for fuel. The load on the engine is constant, as it consists of nothing but street lighting. The load consists of 125 series alternating-current, 6.6-amp arcs operated from a 75-kw, single-phase, 60-cycle alternator. For a run of 13.5 hours with this load, about 1400 lb. of fuel is required. If the load is counted as two lamps per kilowatt, this would make a total load on the engine and generator of 52.5 kw. A 13.5-hour run would, therefore, call for 844 kw-hours, which would make the coal consumption 1.66 lb. per kw-hour. The operators of this plant had the usual amount of trouble which seems inevitably to be experienced with a gas-producer plant the first six months of its operation before the operators learn how to manage the plant. Since then, however, the operation has been very reliable and satisfactory in every way, and, on the whole, it appears to be less work than a steam plant.

Central-Station Exhibits at the Canadian National Exhibition.

The Toronto Electric Light Company, Limited, was represented by an interesting exhibit at the Canadian National Exhibition held at Toronto, from Aug. 28 to Sept. 11. This exhibition is perhaps the greatest annual fair held on the North American continent, and is visited by fully 100,000 people daily.

A space 43 ft. x 13 ft. was occupied under the dome of the Industrial Building, a great iron and concrete structure. The exhibition was in two parts, devoted, respectively, to power and industrial heating appliances and to illumination and domestic heating specialties. Motor manufacturers and dealers in Toronto were invited to display their machines in the booth, and the co-operation was secured of the cash-register and adding-machine dealers, as well as many manufacturers of heating appliances.

The booth was brilliantly illuminated with tungsten lamps and holophane reflectors. Electric signs were installed, with appropriate mottoes, and the exhibit as a whole received much favorable criticism on the part of the visiting public.

Figures from the Iola (Kan.) Central Station.

By Guilford Cresse Glynn.

Iola, a southern Kansas town of about 10,000 people, was the first city in the West to develop its natural gas in large quantities. This resulted in the location of numerous zinc smelting plants and the use of gas in rotary kilns and large gas engines in plants engaged in the manufacture of Portland cement. With the growth of the city, Iola promptly adopted municipal ownership of its gas, water and electric plants. At first the city had no adequate accounting methods, but this condition of affairs was remedied in 1907 by an inventory of the city's holdings and placing proper valuations thereon.

In establishing the present value and fixing the proper depreciation rates (see tables), the writer had recourse to the expert advice of Gunn, Richards & Company, of New York, and also to the local accountants of the Portland cement companies, together with that of the Hunt Engineering Company. It will be noted that the rates of depreciation are rather above than below those generally given for like equipment in current engineering literature, the risk from obsolescence being considered greater where natural gas is used, for the reason that a change in the price of fuel would change radically the nature of an equipment for efficiency. A modern system of municipal accounting was then put in practice and the benefits were almost immediately apparent.

A brief comparison of data from this plant with that from the Marquette (Mich.) municipal plant, published in the *Electrical World* of Feb. 11, 1909, is made in the accompanying tables. The Marquette plant has water-power; the Iola plant uses natural gas under its boilers and has a very ordinary steam plant, having an efficiency less than half that of a modern well-conducted steam plant.

The investment per kilowatt is unusually low in both plants. At Iola this is for the reason that the capital charge for land and buildings is divided in proportion to the bonds issued for water and light (water, $70,000; light, $10,000). The installation has been increased very economically by exchanging existing equipment for other equipment without proportionate increase in cost, the low fuel charge making the simplest kind of installation the most profitable from an investment standpoint.

The present equipment consists of two horizontal tubular boilers and three marine boilers rated at 80 hp. The day load is carried by a 120-kw Warren alternator, direct-connected to an Ideal high-speed engine running at 255 r.p.m. The night

load is carried by a 200-kw Warren alternator, belted to a Monarch Corliss engine, which also drives the two 80-light arc machines (moonlight schedule). The latter engine is capable of developing over 400 hp. The pumping plant is operated as nearly as possible off peak and only rarely is the entire boiler equipment used.

The plant has been hampered in its revenues heretofore by insufficient charges and non-payment of its service for street arcs. This has been changed, and proper credit is now given the plant for service rendered. This credit is $3 per month for each 500-watt, enclosed, direct-current arc lamp and $1.25 for each 100-watt tungsten used in street lighting. Competition with the gas plant for lighting has also affected the revenues. Gas burned in Welsbach gas lamps, at a 10-cent meter rate, furnishes a stiff competition and the city's gas superintendent is as keen for business for his department as if it were a private plant.

TABLE I.

	Iola.	Marquette.
Population served	3,000	10,000
Kw-rating of station	280	850
Total liabilities per kw of station equipment	$93	$82
Gross yearly income per kw of station equipment	$35	$65
Gross yearly income per $100 liabilities	$38	$79
Yearly operating expenses per kw of equipment, exclusive of interest and depreciation	$20	$26.50
Per cent of gross yearly income spent for operation	54	39
Yearly operating expense per $100 invested	$40	$32
Average income per consumer	$45	$37
Total connected load per kw of station equipment	1.25	2.6
Yearly load factor, per cent	20	30
Gross yearly income per capita	$1.10	$5.51
Investment per capita	$3.00	$6.95
Watts station equipment per capita	20	85
Number of customers per 100 of population	3	14.8
Number of residence customers per 100 of population	½	10.4
Number of residences lighted	50	1,040
Number of business places lighted	205	375
Number of motors installed	22	70
Flatirons	12	540

TABLE II.

	Capital Invested.	Depreciation, Per Cent.
Land and water-rights	$1,500	
Buildings	381	5
Engines	6,000	7
Boilers	3,850.23	10
Power transmission	2,200	
Dynamos	3,043.09	7
Alternators	2,924.25	7
Switchboard and accessories	741.31	8
Pole lines	4,804.84	12
Wires	7,405.32	2
Arc lamps	2,169.80	20
Equipment	938.28	
Transformers	3,046.86	8
Meters in service	570.27	15
Motors	102.22	10
Incandescent lamps (City)	88.54	

TABLE III.

Showing the unit cost per kw-hour, based on 352,000 hours, load factor of 20.

Maintenance items shown in Table II	$.0014
Operation:	
*Fuel (5-cent gas)	.0035
Oil and waste	.0011
Wages	.00317
†Water	.....
Fixed Charges:	
Office expense	.00114
Salaries	.00306
Interest	.0007
Depreciation (12%)	.0047
	$0.0197

*Seventy cubic feet of gas burned per kw-hour.

†Water plant in connection. No charge has been made for water. The costs for pumping complete against 200-ft. head is 4 cents per 1000 gal.

It was only with the advent of the tungsten lamp that serious inroads were made on the gas mantle with 4-cent energy as the competitor. These lamps became immensely popular, displacing gas lamps and commercial arcs for store lighting. In addition, the city has placed over 90 100-watt tungstens with prismatic reflectors upon cables, suspending them 10 ft. above the 20-ft. cement walks every 25 ft. The first cost is borne by the merchants, and repaid by the city in light at the rate of 75 cents a lamp a month. It has proved profitable to the city and satisfactory to the merchants, and the breakage, which has been slight, is borne by the latter.

The fuel charge for gas is low, but the writer is convinced that it is practically correct. The measurements were carefully made for a period of some months, and are supplemented by the experience of other gas users in local plants. In addition to the separation on capital cost, the operating cost was also computed from the steam used (boiler horse-power) based on the average of several extensive tests, made by switching the load for pumping water alone, arc lighting alone, incandescent circuit alone, etc. The method of burning gas has some little effect toward economy; not startling, but still distinctly of advantage. The burners are arranged beneath checker work of brick, much after the manner of exaggerated Bunsens. The flow of air and its control is much better than in the numerous "cannon type" of Bunsens, such as the Kirkwood, Equitable, etc., which have been tried in competition and which are still retained in two of the marine boilers. Boilermen can regulate the amount of air through the ashpit to the burners to a nicety, maintaining the same stack temperature day after day, with but little change.

The rates for energy are 4 cents per kw-hour for lamps and from 3½ cents to 2 cents for motors. The latter rates are based upon the hours of guaranteed use per kw-rating of connected load. For example: Two hours' use a day of each kilowatt connected commands a rate of 3½ cents, and for each hour added a reduction of ¼ cent is made in the rate until eight hours' use is reached per kw-rating of connected load, when no further reduction is made. There is also a proviso allowing the city to shut off motor users should the load infringe on the lighting load. It is not probable that this right will be exercised. The rates were designed to meet gas-engine competition, and the campaign for day motor-load business is already improving the finances of the plant. The year's surplus of $8,500 is largely due to this aggressive policy.

Recent Extensions of Central-Station Service in Chicago.

After the summer vacation the campaign for new business for the Commonwealth Edison Company, Chicago, is proving remarkably successful, and a number of notable additions to the load on the central station are reported. Among these is the large new building of Hart, Shaffner & Marx, clothing manufacturers, at Monroe and Market Streets. There was a decided tendency toward the installation of a private plant in this building, but the Commonwealth Company secured the business, which will amount to 916 16-cp lamps, 697 5-amp arcs, 239 hp in motors for general purposes and 240 hp in elevator motors. Another interesting new customer of the Commonwealth Edison Company is the Palmer House on State Street, probably one of the best-known hotels in the United States. Notwithstanding the prominence of this hotel, it is rather surprising to find that up to this time only two floors have been lighted by electricity, gas being used on all upper floors. The whole building is now to be wired and rewired, and the isolated plant which formerly supplied electricity for the two lower floors will be abandoned. About 4500 50-watt equivalents in lamps and motors will be needed in this large hotel. Another hotel recently added to the central-station service is the Plaza Hotel at North Clark Street and North Avenue, overlooking Lincoln Park. Here also a private plant will be discontinued and electricity from the central-station company will be relied on exclusively. It is interesting to note, also, that the hydraulic elevators in this hotel will be changed over for electric operation, and the elevator load will form a considerable portion of the demand for electricity in the whole building.

Twenty-Four-Hour Constant House Load.

An English central-station engineer has proposed an electrical supply system, according to which a definite amount of electrical energy—such as 50 kw-hours per month—would be sold to a householder, to be paid for in advance and to be utilized in an equipment supplied by the central station, consisting of lamps and cooking and water-heating apparatus. By means which it is proposed to devise, the current would have a constant value during the 24 hours. When not used for light or cooking the energy would be used for water heating.

Power Used in the Manufacture of Lumber.

Mr. C. H. Scott, of the General Electric Company, read a paper at the annual convention of the Michigan Electric Association at Detroit in August on the subject of the electric drive in wood-working, which is of interest to the large percentage of the central-station companies in towns where there are wood-working establishments. Mr. Scott said that the company with which he is connected started several months ago to investigate the installation of its motors for wood-working machinery. While the tabulation undertaken is not yet complete, he is in receipt of advices from 256 customers taking central-station power, 64 of whom report installations aggregating 3000 hp. He expects later to have available accurate and complete figures bearing on the use of central-station power for the wood-working industry.

CENSUS FIGURES ON THE WOOD-WORKING INDUSTRY.

The United States census reports for 1905 show that the industry engaged in the remanufacture of lumber ranked second in the number of establishments, fifth in capacity, third in the number of wage earners, sixth in total cost of material and fourth in value of products. Prior to 1880 New York and Maine led in value of lumber products. In 1896 the tide of business flowed to the Lake States, Michigan, Wisconsin and Minnesota. In 1905 the seven most important lumber-producing States in the order of their production were Washington, Wisconsin, Michigan, Louisiana, Minnesota, Pennsylvania and Arkansas. The total horse-power devoted to remanufacture of lumber in Michigan was 25 per cent of that used for all purposes. The power rented from central stations was only 0.06 per cent of the total and 2.3 per cent of the central-station output. Present-day statistics would undoubtedly show more favorably as regards the central-station proportion of the total. Still, the writer believes the situation is capable of much improvement from the central-station standpoint.

SOLICITING POWER.

In soliciting power for wood-working, as well as other industrial establishments, success depends on the aptitude of the central-station power solicitor to analyze correctly operating expenses and fixed charges of existing plants. The ability to do this will go far to demonstrate definitely and convincingly to a prospect the waste and general field for improvement in his power layout. Much good power business has been lost by the use of rule-of-thumb or hit-and-miss methods. Specialized knowledge is indispensable. The solicitor should possess sufficient knowledge as to the design and operation of electrical apparatus in general and motors in particular, and also practical training, so that he may understandingly approach on equal ground the managers, engineers and foremen of the lumber plants. It is a good plan for the solicitor to familiarize himself with the names, operations and functions of the machines ordinarily used in lumber manufacture, since a knowledge of the driven tool is essential if a proper motor is to be selected for it. In addition, the superintendent or owner will be impressed favorably if the solicitor can converse understandingly regarding the remanufacture of lumber and the machinery used for that purpose, and will be apt to assume that such knowledge presupposes an equal facility in applying the proper electric drive. The solicitor should tabulate for record the essential figures in connection with each installation, since the value of the accumulated knowledge thus obtained will prove invaluable in the solution of future power problems. The solicitor himself will each year profit by the experience gained and become a better business getter. Central-station managers should make it obligatory that solicitors make out for filing a permanent record of the data suggested. While this is done by most large central stations, the practice often prevails of keeping information properly belonging to the employer under the hat of the employee. A high-grade solicitor should accumulate working data concerning steam and internal combustion isolated plants, and should be able to estimate promptly the numerous items which make up fixed and variable charges. He should also know the water rates of different types of steam engines and pumps commercially used, the cost of coal, lubricants, water and supplies and the cost per horse-power installed for complete small plants.

The power engineer should, in company with the customer or his engineer, first consider carefully whether the existing grouping of machines is the best possible to secure the most convenient handling and advantageous sequence of operation throughout the various processes of manufacture, effecting whatever changes may be conducive to better light, greater cleanliness, more ample passageways, less danger to operators and the exclusion of losses between the power source and the cutting edge of the tool.

The paper gives alternative methods of laying out the drive for a typical wood-working shop consisting of one or several buildings. There are several ways of applying electrical power, each varying in the amount of first cost, the advantages in operative economy, etc., being proportionate to the capital investment decided upon.

(1) The most elementary method would be to install a single motor of sufficient capacity to run all the machinery operated. This would do away with the existing engine plant, but would permit little or no change in the arrangement of tools or shafting or the abolition of main, jack and counter shafts. The importance of reducing to a minimum all unnecessary friction losses is apparent if we consider the yearly cost of power if constantly used. For example, a loss of horse-power 3000 working hours per year at a 4-cent rate is equivalent to $90 per year. The arrangement suggested is also defective in that all the driven machinery is dependent upon one unit, whose breakdown might occasion the complete stoppage of the plant.

(2) A modification of the first method, by applying group drive in each shop or for separate departments or by connection to economical sections of the main line of counter shafting. This method, however, like the first, might not permit any more favorable arrangement in location of tools than method number one.

(3) A rearrangement of the tools with reference to departments and locations, providing for the best sequence of work through the shop, and a combination of group or individual drives such as to place tools constantly used so far as possible in groups, and providing individual drives for machines which are more or less isolated and used intermittently.

(4) An individual motor for each machine except in particular cases where groups or machines may be so operated as to give a high load factor, or in other cases where the instantaneous demands for power may make it advisable to draw upon the "diversity factor" of a motor operating more than one machine and where maximum demands for power do not come simultaneously.

The last method suggested offers so many superiorities, both from an operating standpoint and as regards the cost of metered current, that in the majority of cases the additional capital outlay is justified to secure the advantages entailed. A carefully prepared report would allow the solicitor a chance to demonstrate the successive advantages of the four methods outlined.

POWER REQUIRED TO DRIVE.

The power required to drive wood-working machinery varies widely according to the hardness and relative humidity of the wood used, the speed and depth of the cut, the physical condition of the knives, saw teeth, or other cutting tools. New and stiff machines, such as triplet drum sanders, may take considerably more power than after a few weeks' limbering up. Dull or wrongly adjusted knives may result in a drain of 200 to 300 per cent on the power source over what would be required if the machines were in the very best order.

Particular care should be taken in recommending motors for large planers, matchers, surfacers, band re-saws, etc., where a wide variety may exist between the classes of lumber remanufactured and the feed and speed used. With light machines, such as dado, variety and combination saws, jointers,

tenoning machines, column and drum sanders, bench borers, etc., the general character of the work and margin of power usually allowed by manufacturers in specifying horse-power to drive minimize to some extent the danger of under-motoring.

The majority of wood-working establishments are devoted to certain classes of work, and those working soft wood seldom work the harder varieties. When in the former case there is a small amount of hard wood to be remanufactured the overload capacity of a good motor is usually ample to take care of such occasional overloads on the driving unit. It is well to remember in this connection that the power required by wood-working machines varies directly with its speed, so that the load is diminished by not forcing the material through the machine at so fast a rate. Where machines are constantly to work very hard wood, such as lignum vitæ, the motors should be at least twice the ordinary horse-power employed for soft wood remanufacture.

Again, the load on a wood-working machine is under most conditions of an intermittent character and the driving motor may often be rated at its temporary overload capacity, since the rapidity of feed and the consequent quick completion of cut allow frequent intervals of rest before another piece of work can be fed in or made ready.

DETERMINATION OF POWER.

Power required to drive a given machine or machines may be obtained with exactitude or approximately estimated as follows:

(1) Guarantees from manufacturers on the performance and power of a given machine with stated feed, cut and material.

(2) By the use of a temporarily installed motor with proper indicating or graphic recording instruments to record the wattage input to the motor and therefrom the power required by the working machine. As a means of obtaining a continuous and exact record of the performance of a given machine or machines the graphic or curve-drawing wattmeter is for many reasons usually preferable to instruments of the recording or indicating type.

(3) The power to drive may be roughly calculated by observing the speed, diameter and width of the belt to the driven pulley of the machine. This method involves, however, a decided chance for error, since the pulleys are usually proportioned so that the driven machine may, if necessary, be belted for the maximum duty. However, for ordinary service, woodworkers estimate that a belt 1 in. wide will transmit 1 hp at 1000 r.p.m., and double belting 1½ hp under the same conditions.

(4) When group drive by engine or a single motor is used, indicator cards on the former and meter readings on the latter may be taken on one or a number of driven machines doing actual work. By repeating the test "running light"—that is, with belts on loose pulleys—the friction loss may be recorded and a subtraction of the result from the full-load reading will show approximately the useful energy expended by the machines themselves. This method, due to the increase of friction with increase of load, and the introduction of other variables, is liable to error and consequently incorrect deductions, especially where the friction load may be as great or greater than the useful load. Still the results may assist in predetermining the net power required, as well as often showing great waste in the existing transmission system.

The wide difference in power required to drive may be illustrated by taking at random several cases of machines actually tested in a wood-working plant.

A motor driving a 24-in. buzz planer with a cut 2½ in. wide x ⅛ in. deep took 2.1 hp, or with a cut 13 in. x 5/16 in., 4½ hp.

A motor driving a 24-in. cylinder planer with a cut 6 in. wide and 3/16 in. deep (in dry spruce) took 4.1 hp; and with a cut double the width and only ⅛-in. depth (but with the same wood wet) required 18 hp.

A 10-in. circular saw with ½-in. cut and easy feed took 2.7 hp, and in 2½-in. hard wood required 8 hp.

A 15-in. tandem scraper (in rock maple), one knife cutting, material 6¾ in. wide with shaving 0.0035 in. thickness, required 3¼ hp. With two knives cutting material 13½ in. wide and 0.009 in. thick, 9 hp was required.

A 42-in. single scraper (in rock maple), with feed 82 ft. per minute width of material, 29 in., thickness of shaving 0.004 in., took 5½ hp. With the same width of material and double the thickness of shaving 9½ hp was required.

A 30-in. single surfacer (in soft pine), with feed of 34 ft. per minute, cutters running at 4200 r.p.m., material 10 in. wide, 1/16 in. cut, required 4½ hp. With the width of material increased to 29 in. and the depth of cut to ½ in., 36.5 hp was required.

A 30-in. double surfacer (in soft pine), with feed of 34 ft. per minute and cutters at 3800 r.p.m., required, with cut 8 in. wide and ¼ in. at the top and ⅛ in at the bottom, 11½ hp. With feed of 60 ft. per minute, cutters running at 4200 r.p.m., width of material 29 in., depth of cut at top 3/16 in. and at bottom ⅛ in., required 38 hp.

All the above shows the necessity of studying the requirements of each machine. Cases have been noted where data taken from pattern shops were wrongly applied to other shops where the machinery is employed for heavy cuts on hard wood. In such cases machines may require double or triple the capacity of the pattern shop.

SELECTION OF MOTORS.

Owing to the high speed and light moving parts of wood-working machines and the frequent violent application of the load, it is desirable to use the belt drive rather than gears or chains, especially as the speed of the driven pulley is usually too high to permit of other than direct or belted connection. The direct drive is coming into vogue in many up-to-date wood-working plants and is giving excellent results where the motor has a sufficiently generous rating to accelerate rapidly and to withstand overloads. As the average depreciation of belting averages 36 per cent per year, it is important to reduce this wastage and, furthermore, do away with any source of slippage between the driving unit and the working pulley.

If belts are used, it is strongly recommended not to run them vertically or with so decided a vertical component as to minimize the arc of contact on the driving pulley and also prevent the use of the belt tension adjustment on the motor base. Motors may often be conveniently located in an inverted position beneath the floor bearing the machine. If this method is adopted, the belt between the motor and the machine should be boxed in and the drive arranged as above stated, at a sufficient angle to be able to make use of the belt-tightener arrangement. There is a wide opportunity for the solicitor or power engineer to use his ingenuity in the layout and novel methods of drive for wood-working machinery.

One of the most difficult loads for the central station to handle is that of the large exhaust blowers which are used to exhaust the refuse material from the machines. Depending upon the size of the shop, one of these blowers may take from 20 hp to 150 hp, and the load is naturally constant throughout the working hours of the plant; therefore, the resultant bill, if central-station energy is used, is liable to be a serious obstacle to the customer's adoption of motor drive. In the plant of the Haffner Furniture Company an innovation was used which promises amelioration of this difficulty. In this installation only one small pipe is used, leading from each individual machine direct to a special cyclone dust and shaving separator, a small direct-driven blower being installed in the pipe of each machine. The important fact to be noted is that under ordinary conditions not more than two machines in any special group are in use at the same time. Hence abnormally large blowers and ducts are not required and the economy of the blowing system is very marked.

The solicitors should be prepared with data which will allow them to estimate, at least roughly, the cost of the apparatus necessary and the fuel required to heat properly the building where the exhaust from the steam power plant is not used for this purpose. On this subject as well as steam needed for

kiln drying the writer is also collecting data which he believes will be of considerable value to the central-station interests.

SALE OF WASTE PRODUCT.

The argument is frequently offered that waste material cannot be used, and therefore it would be poor economy to discard the existing isolated plant for central-station power. In one case an arrangement has been made for utilizing the mill refuse in a small town where the local central station furnished electric power to a planing mill half a mile from the generation station, and also to a sawmill about 1000 ft. away. In part payment the refuse from these two mills is taken by the central station for fuel. The electric company made a rate to each mill of $50 per horse-power per year and allowed the half of this charge as a rebate for fuel supplied. In the case at hand, which involved the use of 40 hp in motors, it is calculated that the wages of one man is saved, aside from productive economies and other advantages. In the case of a sawmill which used 100 hp, it is estimated that a saving of about $5 per day was made. Another case is that of a large box-making factory taking power from the central station, there being 40 motors installed totaling 470 hp. This company disposes of about 2500 cords of kindling wood per year, retailing at about $5 per cord, and in addition about 70,000 bales of shavings per year retailing at about 40 cents per bale. While local conditions will have to be taken into account, the above would serve to refute the argument so frequently offered that it is impossible to dispose of waste wood, shavings, etc., which may best be burned under the boilers of the isolated plant.

COST OF OPERATING BY CENTRAL-STATION SERVICE.

While undoubtedly there may be cases where the arguments of the central station may not irrefutably prove that the use of metered power will be most economical or advantageous, there is very great chance to add largely to the central-station load for this class of service if all the salient talking points are properly marshaled to the front and the solicitor prepares himself to handle understandingly all phases of the situation. Records from a large number of central stations where woodworking plants form a goodly portion of the load indicate that the load factor of such establishments make the use of metered power decidedly feasible. For instance, one of the largest central stations in the West, with 3522 connected horse-power, employing 234 motors (most of these group driven), found that the load factor was 33 per cent. With individual drives the average in many cases will be as low as 8 or 10 per cent, and seldom exceed 20 per cent.

INTERIOR WIRING AND ILLUMINATION

Care of Tungsten Street Lamps.

Mr. Fred T. Masterson, of Grand Rapids, gave the following information at the convention of the Michigan Electric Association, Aug. 17, on the maintenance of lamps used on the Grand Rapids street arches:

The first arch installation consisted of 270 60-cp, 6.6-amp, series tungsten lamps operated 18 in series across 220 volts. Each series of lamps was suspended from a messenger wire stretched across the street and placed about 100 ft. apart. The distance between lamps is 5 ft. and the distance of each lamp below the messenger wire was regulated so as to give an arch effect. This system of lighting for business streets has become so popular in Grand Rapids that at the present time 1103 of these lamps are in service and contracts for 270 more, making a total of 1373. The contract price for each lamp is $7 per year, which makes an income of $9,611 per year.

Considerable trouble was experienced at first in renewing burned out lamps, as it was necessary to draw the arches to one side of the street so that the lamps could be reached from a ladder placed against a building. This system was quite expensive, as it required the services of four men to handle the extension ladders, and also shortened the life of the lamps and did considerable damage to the wiring of the arch.

Some time ago the power company had a wagon built for use in renewing lamps, consisting of an ordinary one-horse dray with a tower built on it. The top of this tower is 15 ft. from the ground, and a three-piece extension ladder is fastened to the side of it. All that is necessary is to drive this wagon below the lamps, raise the extension ladder and change the burned-out lamps. This operation requires about five minutes for each lamp and requires two men, one to drive the horse and the other to raise the ladder and change the lamps. This wagon has been the means of saving the company considerable money both for labor, lamps, and repairs to the wiring.

On June 8 of this year, the first installation of 270 lamps had been in operation one year. During this time the lamps burned 1920 hours and consumed 41,000 kw-hours of energy. The number of lamps renewed was 196, which cost the company $225. This makes the cost of renewals 0.55 cent per kw-hour for lamps only. The labor necessary to care for 1100 lamps will not exceed $200 per year, or $50 for 270 lamps, which makes the total cost of lamp renewals $275 per year, or 0.67 cent per kw-hour.

The one drawback to the series tungsten lamp operating from a constant potential circuit is the extinguishing of all the lamps in the arch when one lamp burns out. This, however, is not very serious if the lamps are inspected each morning, as the defective lamps can be immediately replaced, and it is very seldom that an arch has been out two nights in succession.

On one street in Grand Rapids the multiple tungsten lamp has been tried with very good results. This installation consists of 60 100-watt lamps which have been in operation six weeks, burning on an average of three hours per night, and so far only two lamps have been renewed. This speaks very well for the multiple lamp, as during that time there was two quite severe wind storms.

Albany Park Ornamental Street Lighting.

Albany Park is a large subdivision in the northern part of Chicago which has recently been cut into lots and offered for sale. As one of its attractions a sort of parkway entrance gate effect, something like a court of honor, has been arranged on the various streets, marking the boundaries of the subdivision, in the manner shown by the accompanying illustrations. The concrete structure is built between the sidewalk and the curb, extending across the parkway. At each end of this structure are posts of unequal height. The one on the side next to the curb supports a tungsten 60-watt lamp enclosed in an opalescent glass globe mounted in an ornamental iron holder. The smaller column on the sidewalk side of the concrete structure is surmounted by a stone ball. Both columns have cut-stone capitals,

FIG. I.—ALBANY PARK, CHICAGO, ORNAMENTAL STREET LIGHTING.

and the fine curved sweep of the concrete structure between them is finished by a cut-stone coping enhanced by a grill of ornamental iron work. There is a concrete post corresponding to the smaller one of the concrete structure just described on the other side of the sidewalk from it, and bordering on the lot line. An ornamental iron fence leads back across the lawn to

the building line from this post. The structure is placed on the corner of an alley, so that the alleys as well as the streets are lighted. The post, surmounted by the lamp, contains a hollow space 8 in. in diameter through which the wires are led to the lamp. To it is fastened a handsome bronze plate giving the

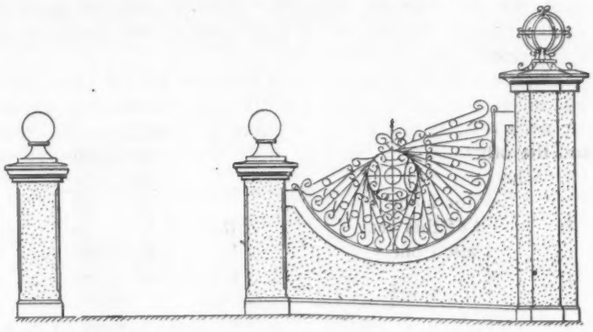


FIG. 2.—ALBANY PARK, CHICAGO, ORNAMENTAL STREET LIGHTING.

name of the subdivision and the particular street on which the structure is placed.

Across the street is a corresponding section of this street decoration, but reversed so that each "entrance gate"—if the expression is the correct one—has two lamps, the higher pillars opposing each other on each side of the curb line, as shown in one of the illustrations. The post supports the lamp about 10½ ft. above the street level. The smaller posts topped by the stone balls are 6 ft. 8 in. high, and the horizontal dimension of the concrete structure across the parkway varies from 10 ft. to 11 ft. 6 in. The lamp posts are octagonal in section, while the smaller posts are square with chamfered corners. Thirty-two

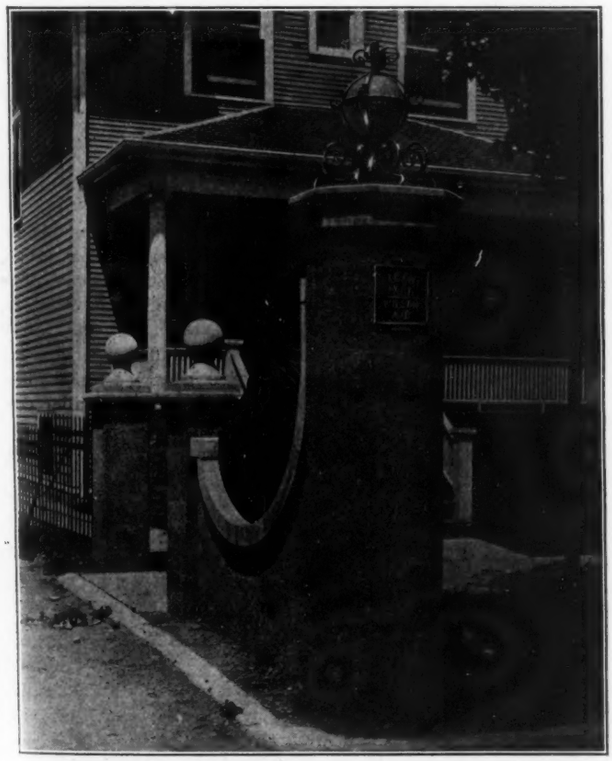


FIG. 3.—ALBANY PARK, CHICAGO, ORNAMENTAL STREET LIGHTING.

of these ornamental sets, containing 64 lamps will be placed on the property. The structures were designed by Messrs. Bostrom & Olson, contractors, Chicago, following suggestions made by the owners of the property. The lamps will be controlled from one central point at the corner of Kedzie and Montrose avenues, where the office of the subdivision is located. The Commonwealth Edison Company will supply the power for the lamps in these ornamental structures, 14 of which, with 28 lamps, are already in place. All houses in the subdivision are being wired for electricity, and the central-station company is laying its mains all through the district, which is witnessing a notable development. By an arrangement with the Commonwealth company made by the proprietors of the subdivision, the lamps will be maintained for three years without expense to the lot owners. After that, an arrangement may be made with the city for maintenance.

An Experimental Study of the Globe Photometer.

BY A. A. PERRINE.

MUCH attention has been given in the last few years to the development of photometers designed for the measurement of mean spherical and mean hemispherical intensities of light sources.

The method used by the early experimenters was the well-known point-to-point method—that is, the measurement of candle-power in a large number of directions distributed uniformly over an imaginary sphere surrounding the lamp. This method has been frequently resorted to; it is very laborious, but leads to substantially accurate results.

Several forms of integrating devices have been developed at different times, but none has been as simple in construction or as satisfactory as the globe photometer. The globe photometer is a simple instrument intended for the measurement of mean spherical candle-power of a source at one reading.

Slowness has characterized the investigation of the globe photometer in this country, possibly because the Matthews integrating photometer has been used in the leading photometric laboratories, although its simplicity and other meritorious features have been appreciated.

The study of the photometer here recorded was made in the laboratories of Armour Institute, Chicago, by the writer and Mr. George G. Goheen. The globe photometer used was made in the form of a sphere, 120 cm in diameter. The frame of the globe is made in two hemispheres, being formed of office netting. The interior of the frame thus formed was lined with a thin coating of asbestos 0.1587 cm thick, cut into segments so that they would fit readily into place, and secured to the netting by small wires. A second coating of asbestos segments 0.1587 cm thick was placed upon the first and secured to it by a silicon compound. The hemispheres were then placed together and rigidly secured by metal clamps.

The interior of the sphere was coated with a white paint called "Naples Velvet Finish." An opening was provided in the upper portion of the sphere 46.356 cm in diameter for the purpose of inserting lamps and repairing the inner surface. One observation window, covered with a diffusing glass, was provided in a central, horizontal position, from which readings could be taken conveniently by the measuring instrument.

The brightness of illumination of the observation window was determined by the application of a photometrical bench, located outside of the window, in line with the beam of light from it.

The walls, ceiling and floor of the room where the investigation was carried on, and all objects within the room, were either painted black or screened from the light of either source by black cloth, all external light being excluded.

The mean spherical candle-power of a carbon lamp, bare and with Holophane reflectors B, C and D, was found by determining the actual candle-power of the lamp in a large number of positions in a vertical plane. These values were then plotted on polar-flux paper, from which the mean value could be determined.

The lamp used was balanced against a standard 110-volt, 16-cp lamp secured from the Electrical Testing Laboratories. The potential over the lamp was maintained constant at the required value by means of resistance.

A 7.49-cp Buckeye carbon lamp was used as a standard when the test lamp, which was a 21.2-cp Edison, was inserted in the sphere, care being taken to insert the lamp as near the center of the globe as possible. The position of the lamp within the globe was then changed by raising it vertically from the center by increments of 10 cm until the maximum distance above the center of the sphere was reached, care being taken to keep the lamp in the center of the upper hemisphere. The screen which was used in this case to prevent the direct rays of the lamp from falling upon the window was 12.3825 cm × 20 cm in size and made of sheet iron, and coated with the same white paint previously used; it is spoken of hereafter as a white screen. The screen was adjusted until the luminous filament of the lamp could not be seen from the window. The position of the Lummer-Brodhun box used with the photometrical bench was changed at each position until a balance was obtained to measure the candle-power.

The general theory of the globe photometer, according to Dr. Black, is given in Barrow's "Electrical Illuminating Engineering," page 50, and elsewhere, so it is unnecessary to review it here. The illumination on the window is multiplied by a constant to obtain the mean value of the spherical candle-power.

The effect of different distributions upon the constant by the use of prismatic reflectors was investigated and the results obtained are shown in the accompanying diagram. The bare carbon-filament lamp, which was a well-seasoned Edison 21.2 cp, was first inserted in the center of the sphere, care being taken to arrange the white screen so that none of the lamp filament was visible through the observation window, and the same relative position of the screen to the lamp was maintained throughout the investigations. The lamp was then moved vertically upward by increments of 10 cm until the maximum distance above the center was reached, and the intensity of the illumination at the window was noted in each instance. From this data was determined the constant, or the number by which the illumination observed at the window must be multiplied to give the actual candle-power.

The values of the constant which were obtained with the bare lamp are given by curve *A*. This curve shows that the value of the constant decreased as the distance above the center of the sphere increased up to about 28 cm above, and then increased again. The variation in the value of the constant is attributable largely to the error caused by the screen between the source of light and the window and will introduce a different error for different positions of the lamp, because in some positions more of the direct rays from the lamp will strike the screen than in other positions. It is also evident that for some positions of the lamp the screen will interfere with the reflected flux of light from the part of the lamp where the intensity is a maximum, while in others it will interfere with the flux of light from a less intense part. This interference of the screen with the flux of light will cause the fluxes of maximum intensity to be reflected a greater number of times before they reach the window than will be necessary for them to be reflected at some other position. A certain per cent of the flux of light is absorbed every time it is reflected, consequently reducing the intensity at the observation window and affecting the value of the constant. The effect of the screen will vary with the distribution of the flux of light and probably to some extent with the color of the light emitted by the luminous source.

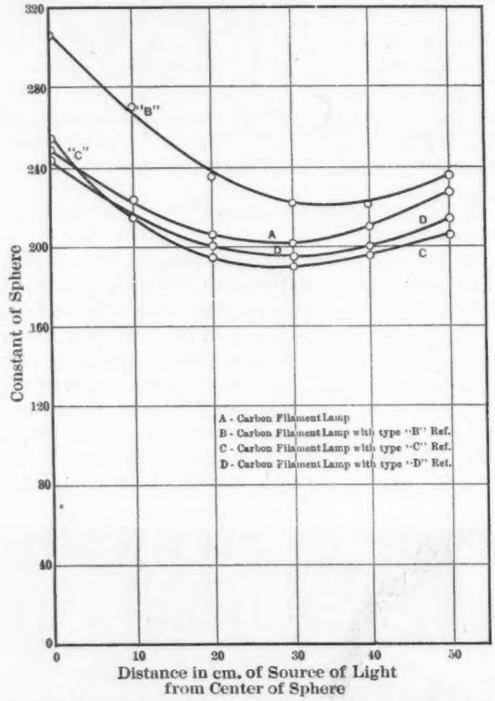
Curve *D* shows the values of the constant obtained when using the carbon-filament lamp with "Type D" reflector. The values of the constant in this case are slightly less than those for the bare lamp, thus showing a distribution favorable to the illumination of the window. It is evident that the absorption of light in this case is less than in the previous case.

Curve *C* shows the values of the constant obtained for the carbon-filament lamp with "Type C" reflector. The value of the constant in all but the central position is less than that obtained for any of the distributions studied.

Curve *B* indicates the values of the constant obtained by using "Type B" reflector. This curve shows a marked increase in the value of the constant over those indicated by curves *A*, *C* and *D*.

It is evident from a consideration of these curves that the distribution of the flux of light has a marked effect upon the values of the constant obtained. Type B reflector gives a nearly uniform distribution of light over a solid angle of 45 deg. on each side of the vertical.

Since the values of the constant obtained for the same position above the center with the different distributions varied greatly, especially in the case of curve *B*, it may be stated that the distribution of the flux of light has a marked influence



EFFECT OF DIFFERENT DISTRIBUTIONS UPON CONSTANT.

upon the constant in some cases. This result is attributable to the greater number of reflections a distribution like that given by the Type B reflector must undergo, and a relatively smaller portion of the illumination contributed to the window is by singly reflected light than in the case of distributions like those of *A*, *C* or *D*. This variation is probably due, to a great extent, to the irregularity in the reflective power of the interior surface of the sphere, and it is also probable that the reflecting power of the reflectors is not the same.

It may well be stated that when the convenience of the globe photometer and the ease with which the mean spherical candle-power of a source can be determined are considered, and knowledge is had of the conditions under which its "constant" varies, one is justified in asserting that it is worthy of more serious attention than it has yet received.

New Telephone Patents.

Semi-automatic exchanges involve a combination of the manual and automatic systems, these being interwoven in various ways. In a system recently patented by Mr. H. G. Webster, of Chicago, Ill., for which he has obtained three patents, all assigned to Mr. M. G. Kellogg, the origination of a call by a subscriber automatically selects a non-busy operator having before her a full jack multiple through which she can complete the call.

When a call arrives upon a connecting machine, the latter at once selects a trunk, this being the first non-busy trunk or the first non-busy operator. The factor used to determine this latter condition, for a non-busy operator, is that of a

non-answered call existing before her. The trunk circuits terminate before the operator's plugs, and the operator having a multiple can readily call, supervise and disconnect. The system is so arranged that the apparatus required is not complicated.

NEW APPARATUS AND DEVICES.

With party lines on the selective basis it frequently becomes necessary to equip each cord pair with several different ringing keys. Where the talking circuit is carried through all these in series with a break contact, the chance for trouble becomes rather great. This may be overcome if an extra key be used which responds to all plungers and breaks the talking circuit for all. Other applications of this same system also suggest themselves, and Mr. J. L. McQuarrie, of Oak Park, Ill., has obtained a patent for such a combination key. His patent is assigned to the Western Electric Company.

SCHREEVE RECEIVER HANDLE

A sort of handle for a watch-case type telephone has been patented by Mr. H. E. Schreeve, of Wyoming, N. J., which the American Telephone & Telegraph Company has obtained by assignment. It is shown herewith. A back strap of sheet metal forms a supporting hook at one end and a handle line at the other.

Patents for two antiseptic devices have recently been issued. One of these is a sheet metal extension mouthpiece slipped over the rubber mouthpiece from the rear. A bead is then spun in it, which clamps the rubber mouthpiece in position and at the same time secures a screen and antiseptic pad. This is the invention of Mr. Geo. H. Reed, of New York City. The other consists of a threaded nipple to be placed between the mouthpiece and transmitter, clamping at the joint on an antiseptic screen. This latter is patented by R. E. Miller, of Dayton, N. M.

LETTERS TO THE EDITORS.

Alternating-Current Waves.

To the Editors of Electrical World:

SIRS:—In the article by Prof. Charles S. Slichter, entitled "Graphical Computation of Fourier's Constants for Alternating-Current Waves," which was printed in your issue for July 15, it was pointed out that the analysis of distorted waves may be accomplished either with the aid of a mechanical analyzer or some purely mathematical method may be resorted to.

With the purely mathematical method one might distinguish between two typical cases of wave-form analysis, as indicated below. In the first case the harmonic components of the curve and their relative time-phase displacements are to be determined such that the value found by the expression

$$\frac{1}{\pi}\int_o^{\pi}\{F(x)-N(x)\}^2 dx$$

becomes a minimum or possibly zero.

In this equation $F(x)=Y=A_1 \sin \omega t + A2 \sin 2\omega t + A3 \sin 3\omega t + \ldots An \sin n\omega t + B_1 \cos \omega t + B_2 \cos 2\omega t + B_3 \cos 3\omega t + \ldots Bn \cos n\omega t$. $N(x)$ represents the actual instantaneous ordinate of the curve. An analysis of this kind will be required by the mathematician and physicist.

In the second case the determination of the fictitious components of the curve is confined to that of the fundamental wave and to higher harmonics, the amplitudes of which exceed a certain value expressed in terms of that of the fundamental wave. An analysis of this kind is what the practicing electrical engineer requires. In other words: For engineering work it suffices to determine the amplitudes of the fundamental wave and of those higher harmonics from which disturbances are to be expected.

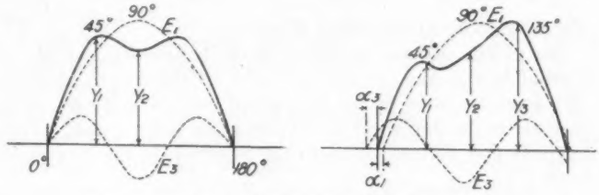
There are instances where the determination of only the value $E \div E_1$ is required, where E = amplitude of complex wave, E_1 that of the component of fundamental frequency.

Whatever the problem in heavy current work may be, it always suffices to determine the amplitudes of the fundamental wave and of one or two members of higher order.

The application of Professor Slichter's method undoubtedly possesses advantages, when an analysis as outlined under the first classification is to be obtained.

For engineering work, however, it would seem that the method which embodies the employment of specially prepared co-ordinate paper and that of a planimeter is too complicated.

Methods of wave-form analysis which meet the requirements of the engineering profession have been developed by various engineers. Mention may be made of the methods of Houston and Kennelly and Fischer-Hinnen. In each of these two methods the amplitude of the fundamental wave can be arrived at only after those of the components of higher order have been determined. The writer has developed a method, published elsewhere, in which the amplitude of any harmonic component is determined in the following manner: Measurement is made of as many ordinates as the complex wave contains harmonic components. The application of a simple formula for each individual component then furnishes the amplitude of the harmonic component under consideration independently one from another.



FIGS. 1 AND 2.—ALTERNATING-CURRENT WAVES.

For example, in the case of a symmetrical wave, as shown in Fig. 1, with the equation $y = E_1 \sin \omega t + E_3 \sin 3\omega t$, E_1 and E_3 the amplitudes of the fundamental wave and the third harmonic, respectively, are found in the following manner:

Erect and measure the ordinates Y_1 and Y_2 as shown.

There are then obtained:

$$E_1 = 0.71\ Y_1 + 0.50\ Y_2;\quad E_3 = 0.71\ Y_1 - 0.50\ Y_2$$

Similarly for a curve of the unsymmetrical type, as shown in Fig. 2, the equation of which may be written: $Y = E_1 \sin(\omega t - \alpha_1) + E_3 \sin 3(\omega t + \alpha_3)$,

$$A_1 = 0.354\,(Y_1 + Y_3) + 0.50\ Y_2$$
$$A_3 = 0.354\,(Y_1 + Y_3) - 0.50\ Y_2$$
$$B_1 = B_3 = 0.354\,(Y_3 - Y_1)$$ thus:
$$E_1 = \sqrt{A_1^2 + B_1^2}$$
$$E_3 = \sqrt{A_3^2 + B_3^2}$$

where A_1 A_3, B_1 B_3 are the sine and cosine members of the components E_1 and E_3, shown in dotted lines.

In a similar manner there may be developed simple formulas with the aid of which the fictitious components of any distorted wave can be determined with a minimum expenditure of time.

CHICAGO, ILL. HENRY HERMANN.

Movement of Magnetic Material in a Rotating Field.

To the Editors of Electrical World:

SIRS:—In connection with my letter in your issue of Sept. 9, commenting upon a letter in your issue of July 22, it seems well for me to state in more detail the reasons for my belief concerning the movement of magnetic material in a rotating field as outlined in the former issue.

The revolving action of the magnetized iron pieces is practically continuous, due to the fact that as they turn they alternately present to the passing rotating field that portion of their edge which is opposite in polarity to that of the rotating field,

and, therefore, the tangential pull of the rotating field on the iron pieces is practically unidirectional and in its own direction as applied to that portion of the iron pieces which is next to the rotating field.

My statement that the hysteretic action is not directly the cause of the rotating action of the iron pieces, and that the hysteretic action is probably slight and incidental is based on the assumption that the hysteretic action is simply the result of the lagging action of the revolving iron pieces—with respect to the rate of charge of the rotating field—and the consequent gradual reversal of polarity in the iron pieces. My contention is that the hysteretic action is an effect rather than a cause.

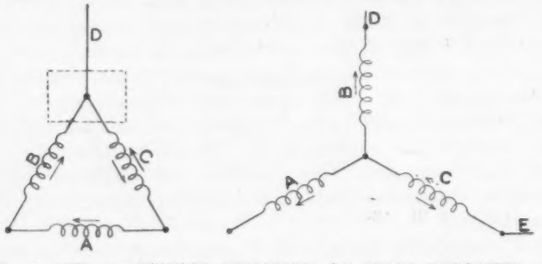
Madison, Wis. C. W. Lange.

Time-Phase Relations in Three-Phase Systems.

To the Editors of Electrical World:

Sirs:—The articles by Prof. A. S. Langsdorf and Mr. F. Conrad in the Aug. 12 and 19 issues of the *Electrical World* give some attention to the time-phase relation and sum of the currents in the line wires of a three-phase delta system. These relations may be made clear to the beginners in the way shown below.

In considering the delta of Fig. 1, the positive direction of voltage may be taken in clockwise direction around the circuit, as shown by the arrows inside the delta of Fig. 1; that is, the voltage in each phase will make an alternation in the direction of the arrows 120 time-degrees in advance of that of the phase immediately following. If the arms *A, B, C* of the delta have similar characteristics the currents will flow around the delta 120 time-degrees apart in exactly the same relation to each other as the voltages.



FIGS. 1 AND 2.—VOLTAGE RELATIONS IN DELTA-CONNECTED AND STAR-CONNECTED SYSTEMS.

Considering phases *B* and *C*, phase *B* may be taken as 120 and *C* 240 time-degrees behind *A*, but *C* will flow in a negative or counterclockwise direction 180 deg. in advance of its positive value, or 240 deg. — 180 deg. = 60 time-degrees behind *A;* as *B* is 120 deg. behind *A*, it follows that *C* reaches its negative maximum 60 deg. in advance of the positive maximum of *B*. The negative direction of *C* is shown by the arrow outside the diagram, and considering the junction point of *B, C*, and line wire *D*, there are flowing toward *D* two currents 60 time-degrees apart. It should be remembered that in considering the current in any wire at a junction point the same law holds in direct or alternating current; namely, the sum of the currents at any instant is zero, assuming the flow into and away from the junction as positive and negative, respectively.

The sign given the in-flowing or out-flowing current, of course, does not matter as long as the signs are the opposite of each other. In considering the current in the line wire *D* then the attention should be concentrated on the point of junction, as shown enclosed by the dotted lines in the diagram, and the proper sign should be given to the two currents *B* and *C* as meeting at a junction point rather than their sign as regards their direction in the delta. In fact, the problem as regards line current is distinctly that of currents at a common junction point, and to try to carry their delta signs into the problem is confusing rather than otherwise to one not familiar with such circuits.

In a circuit as here outlined, it is plain from the above considerations that the currents of phases *B* and *C* are 60 time-degrees apart as regards their junction on line wire *D*, and, therefore, the current in *D* is 1.732 times that in either *B* or *C*. In adding vectors of *B* and *C* it is generally stated in textbooks that the vector of *C* is reversed, which is, of course, the same thing as the foregoing.

In considering the voltage between line wires in a star system, as Fig. 2, the same considerations may be said to apply. The voltages are considered as directed from or into the junction point displaced 120 deg. in time-phase from each other; taking phase *C* it would then have an outward direction from the junction point 120 deg. after *B*, but would be directed into the junction—that is, be negative, as shown by dotted arrow, 60 deg. in advance of the positive or outward direction of *B*. Considering then the voltage between line wires *D* and *E* it is evident that voltages *B* and *C* will add when they have opposite sign—that is, *B* outward, *C* inward, or vice versa—and, therefore, there is between line wires the sum of two voltages 60 deg. out of time-phase, rather than 120 deg., as would be true if their signs as regards the junction point were considered.

Toledo, Ohio. John Gilmartin.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Rectifier.—An illustrated description of a rectifier specially intended for the charging of ignition batteries from alternating-current mains. It comprises a set of vibrating contacts which connect the load circuit alternately to two portions of the secondary winding of a transformer, the connection being so made every half period that a succession of rectified half-waves is delivered into the circuit. An efficiency of 90 per cent is claimed. In Fig. 1 *A* is the primary winding of the transformer, which is connected to the supply mains through a switch. *B* and *C* are the two secondary windings, connected together at *D*. *E* and *F* are two electromagnets wound oppositely and connected in series across one (or both) of the secondary windings. The pivoted steel bar *G*, which is given a permanent polarity by means of the two coils *H* and *J* supplied with energy from a storage battery, is set in vibration by the mutual action of the two alternating-current magnets *E* and *F*. This vibrating system is adjusted to suit the frequency of supply by varying the distance of the magnets from the bar and the tension of the springs *K*. Rigidly attached to the bar is a stiff cross-piece *L*, which carries platinum contact pieces on springs at its extremities. These contact pieces are electrically connected to the nut *M*, which forms one terminal of the direct-current circuit. Opposite to the two contact pieces are two platinum-tipped studs *N* and *O*, connected, respectively, to the free ends of the transformer secondaries *B* and *C*. When the bar *G* is moving toward *F* contact is established at *N*, and the current-impulse corresponding to the half-wave is sent into the direct-current circuit. At the instant when the current passes through zero, the bar *G* has moved to such a position that contact is broken at *N* and made at *O*, so that the current-impulse corresponding to the next half-wave is sent, reversed, into the direct-current circuit. Although the current in the magnet coils *E* and *F* may differ in time-phase slightly from the main secondary current, thus causing the contacts to be made and broken just before and after the current has passed

through the zero point, this has little effect on the working of the apparatus and any tendency to sparking is counteracted by the small condensers *P* and *Q*, which discharge a useful current into the circuit. If desired, an auto-transformer can be substituted for the two-coil transformer, the point *D* being made the middle point of the winding, and tapings being taken off at equidistant points in the winding at either side of *D* for connection to *N* and *O*. Among the advantageous features claimed for this apparatus is that it acts as an automatic minimum cutout, because if the supply of current should fail the

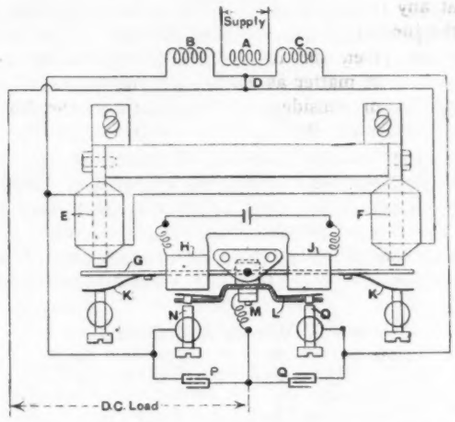


FIG. 1.—DIAGRAM OF RECTIFIER CONNECTIONS.

rectifier will stop and all the contacts in the secondary circuit will be broken so that it will be impossible for the accumulators to discharge through the apparatus. Moreover, the device can work on any load from no load up to full load, an advantage that the mercury-vapor rectifier does not possess.—Lond. *Elec. Eng'ing*, Sept. 2.

Reliability of Electrical Machinery.—Some notes on last year's report of M. Longridge (chief engineer of the British Engine, Boiler & Electrical Insurance Company) on failures of machinery. A considerable increase is shown in the number of failures of gas and oil-engine shafts, such failures amounting to 9.1 per cent of the total failures, compared with 4.7 per cent in 1907 and 5 per cent as the average for 24 years previous to 1907. The rate of break-down among electric motors shows some improvement, the figures for the year 1908 being 1 in 9.2 for continuous-current and 1 in 11.3 for alternating-current motors, compared with an average figure for the two types of machines of 1 in 7.9 for 1908 and 1 in 8.2 for 1906. The figures given above for electric motor break-downs in 1908 compare favorably with the figures of 1 in 9.1 for gas engines and of 1 in 9.4 for steam engines. Dirt and neglect are responsible for at least 30 per cent of the failures, while the manufacturers must be held accountable for fully 11 per cent of the total break-downs. Oil-throwing is probably the most fruitful source of trouble, but not enough care has been exercised to secure efficient locking of spiders, core plates, pole-pieces, etc.—Lond. *Electrician*, Sept. 3.

Stranded Conductors.—A note on a recent British patent of C. A. Parsons, J. H. Greaves and A. R. Hemsted (16,620, 1908; Aug. 26, 1909). Flattened, stranded, coreless conductors, particularly suited for high-speed, smooth-core armatures, and also for slotted alternating-current armatures, are manufactured by twisting wires round a fixed dummy core by means of a revolving drum carrying the spools, and then passing the wire tube so formed between two rollers, which flatten it into the required flat conductor. The wire tube may be formed inside a tubular die instead of round a dummy core. Additional layers of wire may be placed over the flattened cable. The flattening process does not damage the insulation of the individual strands, which may be of cotton or enamel.—Lond. *Elec. Eng'ing*, Sept. 2.

High-Speed Direct-Current Machines.—A note on a recent British patent of C. A. Parsons and A. H. Law (16,704, 1908; Aug. 26, 1909). The conductors are only partly embedded in the iron, so that the self-induction of the windings is not appreciably increased over that of a smooth-core armature, while the use of binding wires is avoided. To increase the magnetic path round the conductors they are made flat and thin, one edge being expanded or shaped so that they can be locked in the slots by wedges or other suitable means. If cable, stranded as described above, is used, it can be previously shaped so as to be held easily in dovetailed slots by passing it between specially formed rollers.—Lond. *Elec. Eng'ing*, Sept. 2.

Damping Coils for Direct-Current Magnets.—K. W. WAGNER.—A sudden disconnection of a magnet coil from its circuit produces high voltages. In order to obviate this difficulty an auxiliary short-circuited coil (damping coil) may be placed on the magnet, so that the magnetic energy which disappears can be transformed into joulean heat in this secondary coil. The author begins to discuss this problem mathematically.—*Elek. und Masch.* (Vienna), Aug. 29.

Constant-Current Motor-Generator Sets.—A note on a recent British patent (5,209, 1909; Aug. 26, 1909) of the British Thomson-Houston Company (General Electric Company of this country) for constant-current motor-generator sets. The armatures of the two machines are connected in series. Each has one set of short-circuited brushes on a line at 90 electrical space-degrees to the main field, and a set of brushes displaced 90 electrical space-degrees to the first set, through which the armatures are connected in series. The load circuit to which constant current at varying potential is to be supplied is connected across one armature.—Lond. *Elec. Eng'ing*, Sept. 2.

Lamps and Lighting.

Incandescent Lamps.—H. L. IRELAND.—An account of tests on the comparative operation of metallic-filament and carbon-filament lamps, with respect to variation of candle-power during life, the temperature coefficient of resistance, and the effect of variations in voltage.—*Jour. of Engineering*, University of Colorado, No. 5.

Photometry.—S. NOWACKI.—An illustrated article making suggestions on the use of photometers in practice, with special reference to some details of the use of the Bunsen and Brodhun photometers.—*Elek. Anz.*, Aug. 19.

Mercury-Arc Rectifier.—A. S. STREAMER.—An illustrated article on the commercial applications of the mercury-arc rectifier.—*Jour. of Engineering*, University of Colorado, No. 5.

Generation, Transmission and Distribution.

Electric Cranes.—H. H. BROUGHTON.—A continuation of his long illustrated serial on electric cranes. The author here deals with the mechanism required for effecting the traversing and traveling cranes. The article opens with a brief discussion of the determination of the size of motor required for each motion, and "constants" of American cranes are given. Then follow notes on slipping drives, axles, axle boxes, roller bearings and track wheels. Constants are given in order to enable the several parts to be proportioned correctly. Traversing and traveling mechanism arrangements are also described.—Lond. *Electrician*, Sept. 3.

Power in Paper Mill.—A. PALME.—An illustrated description of the electric equipment of a paper mill in Toscolano, on the Garda Lake, in Italy. Water-power is utilized, the generating plant containing three 650-hp alternators giving three-phase currents at 6300 volts and 42 periods. The transmission line has a length of three miles. The chief part of the energy is utilized for driving three 300-hp induction motors.—*Elek. und Masch.* (Vienna), Aug. 22.

High-Head Development.—L. ELLIOTT.—A brief illustrated description of hydroelectric development, beginning with the preliminary investigations and touching on surveys, designs and construction work, leading to the completed power plant. The discussion covers the various divisions of the development in the order of the actual occurrence on the stream, from the upper waters to the plains below.—*Jour. of Engineering*, University of Colorado, No. 5.

Installations, Systems and Appliances.

Water Heater.—An illustrated description of a compact electric water heater, in which the electric current passes through the water itself and raises its temperature simply by joulean heat. The apparatus (Fig. 2) consists of a porcelain cylinder *A* with porcelain caps screwed in at each end, the intermediate space being filled up with a series of very thin platinum

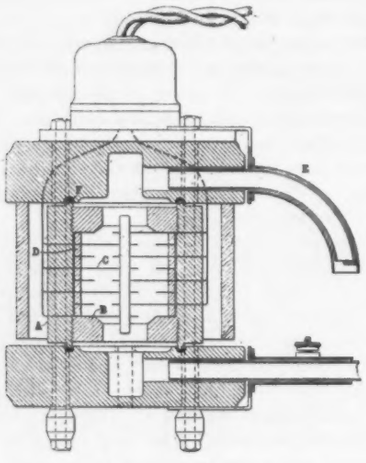


FIG. 2.—WATER HEATER.

diaphragms *C* separated by porcelain rings *D*. The water enters at the bottom and flows upward between the diaphragms through circular apertures cut in them on alternate sides of the center so as to give a zig-zag flow. Alternate diaphragms are connected together, and the two sets of diaphragms are connected to the supply circuit. Current passes between opposite plates when water is flowing through the apparatus and thus heats the water. A certain amount of electrolysis takes place when continuous current is used, but "the oxygen evolved is dissolved in the water and purifies it, while the hydrogen is liberated into the atmosphere." The inner cyclinder is clamped between two thick earthenware end plates by brass rods passing through both these, and outside of the cylinder. The inner edges of the cylinder bear against rubber rings *F* let into grooves in the end plates to make the apparatus water-tight. An outer earthenware cylinder surrounds the whole. The pipes and other external metal parts of the apparatus are earthed to prevent any shock from being received from the apparatus. The water being in direct contact with the pipes also, it is necessary to reduce the leakage current to earth to a minimum. This is done by making the water columns between the diaphragms and the inlet and outlet pipes as long as possible, by providing inner pipes of porcelain, as shown at *E* in the sketch. Moreover, to prevent anyone from receiving a shock from the outcoming stream of hot water a small screw is placed at the end of the pipe. This effectually earths the water as it leaves the apparatus. All the metal parts of the apparatus are in direct contact with the inlet pipe, but in cases where this is connected to the supply system with a rubber pipe, a special earth wire is connected to this terminal. The number of platinum diaphragms to be used with a certain voltage depends on the conductivity of the water.—Lond. *Elec. Eng'ing*, Sept. 2.

Electric Heating.—E. R. Ritter.—An illustrated paper read before the Electrical Society of Karlsruhe. When wires are used as resistors they are liable to be destroyed by oxidation. For this reason a German company uses for resistors very thin mica strips covered with a film of a noble metal. The mica films are about 0.01 mm thick. The thickness of the layer of the noble metal is not more than 1/4000 mm. The author then describes the applications of the new electric furnace product, silundum, which has already been noticed in the *Electrical World*. He then reviews the principles of electric heating and gives some data on cost in comparison with gas.—*Elek. Zeit.*, Aug. 19 and 26.

Lightning Arresters.—A. Garnier.—A theoretical article on lightning arresters containing a number of air-gaps in series. The author first treats with the change of potential along a series of cylinders insulated from each other and separated by air-gaps, if an e.m.f. is impressed on the two ends. He then deals with the effect due to resistors connected in parallel, and finally discusses the physical conditions of the extinction of the arc.—*L'Industrie Elec.*, Aug. 10.

Tariff.—L. Bernard.—The author argues that not only in water-power plants, but also in steam plants, the endeavor should be to use a flat rate in order to make electric lighting more popular. For steam plants he recommends the use of a flat rate for certain hours during the day, which include the chief hours of lighting, say, the time from 9 o'clock in the morning to 9 o'clock in the evening. For service beyond this time the energy should be metered.—*Elek. und Masch.* (Vienna), Aug. 29.

Charging of Storage Batteries.—R. Edler.—An article on the method of Micka and Cisneros for charging a storage battery without increasing the voltage by dividing the battery into three parts. The author describes three methods by which the charging can be carried out with the aid of two ordinary three-pole switches without any technical complications.—*Elek. Zeit.*, Sept. 2.

Wires, Wiring and Conduits.

High-Tension Insulators.—M. Vogelsang.—For the design of high-tension insulators, etc., the author makes use of the curves in Fig. 3, giving the perforation voltages in air and oil. The abscissas are kilovolts. The ordinates give the distance in millimeters which will be perforated. Curve *a* refers to the perforation voltage between horns in air, *b* between points in air, *c* between the plates in air, and *d* between points in oil. If, for instance, the object is to design an apparatus for a perforation e.m.f. of 68,000 volts in air, corresponding to a height of porcelain of 150 mm, then the minimum distance of metallic parts of the apparatus in oil should be at least 36 mm, as this figure corresponds to 68,000 volts in oil. For determining the height of the insulators of high-tension apparatus, the author gives an empirical formula which takes into consideration the voltage and the rating of the central station. If *h* is the height of the

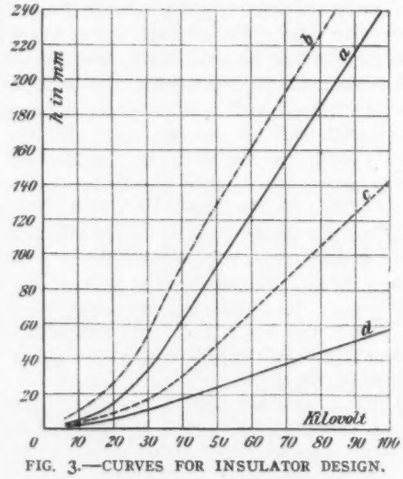


FIG. 3.—CURVES FOR INSULATOR DESIGN.

porcelain insulators in millimeters, *k* the voltage, and *L* the rating of the central station in kilowatts, the empirical formula is:

$$h = \sqrt{k}\left(0.8 + \frac{\sqrt[3]{L}}{30}\right)$$

The author recommends marking high-tension apparatus with the perforation voltage for which they are designed.—*Elek. Zeit.*, Aug. 26.

Ionization of Air by High-Tension Lines.—Houllevigue.—The effect of a thunderstorm following the direction of a high-tension transmission line has called the attention of physicists to the part which transmission lines play in meteorology. One

of the theories advanced is that high-tension lines emit streams of ion which rise and take along enormous electric charges. The author has investigated experimentally whether this is true along a certain transmission line in France. He found that along this line the number of ions positive and negative was almost zero, in any case less than at other places in the neighborhood. Thus it would seem that high-tension lines do not produce ions, but rather capture those which are in the surrounding air.—*L'Industrie Elec.*, Aug. 10.

Traction.

Current Clocks.—Several years ago the Berlin street railways began to install wattmeters on some of their cars to see whether the automatic control thus imposed on the motormen would lead to better running and decreased energy consumption. By the end of 1907 the Berlin company had over 250 wattmeters in service, but since February, 1908, all wattmeters have been removed and every car on the system has been equipped with a clock which runs only when energy is passing through the controller. The change from the complex wattmeter to this simple clock was made after experiments with both instruments on the same car had proved that those with the lowest watt readings also had the lowest current-time reading. In fact, the clock was considered superior to the wattmeter as a gage of the skill of the motormen in using energy for several reasons. The connections of the clock are shown in Fig. 4. It is

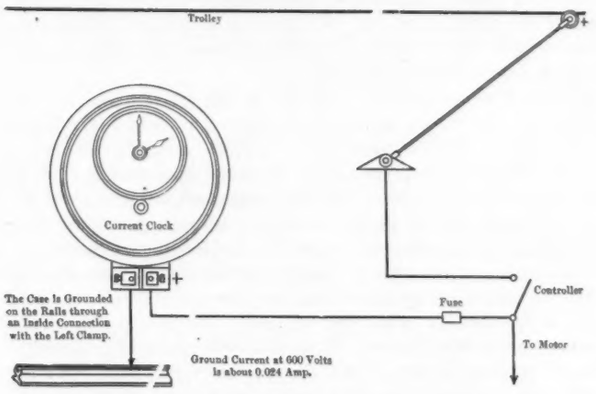

Trolley
Current Clock
The Case is Grounded on the Rails through an Inside Connection with the Left Clamp.
Fuse
Controller
To Motor
Ground Current at 600 Volts is about 0.024 Amp.

FIG. 4.—DIAGRAM OF CURRENT CLOCK CONNECTIONS.

operated by a spring, like any clock, and will run for more than a month without further attention. It is connected in parallel with the controller. The clock is equipped with a pair of coils, which, when magnetized by the shunt current, pull up the armature which holds the balance wheel. As soon as the balance wheel is released the clock begins running and continues to do so until the interruption of the current causes the armature to stop the balance wheel, as before. The entire timepiece is of simple construction and can be grounded for potentials up to 600 volts.—*Elec. Railway Jour.*, Sept. 11.

Electrophysics and Magnetism.

The Ions in Gases.—W. SUTHERLAND.—A theoretical paper in which the author gives the fundamentals of a theory "wide enough to contain the chief phenomena now known." The simplest theoretical ion in a gas is an atom charged with an electron, just as in electrolytic solutions. But the calculations of J. J. Thomson, Langevin and others seem to show that the smallest ions in gases consist of a few molecules, say, two or three. P. Phillips in his experiments on ionic velocities in air with a wide range of temperature finds the number of molecules in a gaseous ion to vary apparently with the temperature. The present author shows, however, that this variation of the size of the small ion in gases is only apparent, that the experimental ion is the simple ion of theory and electrolysis, and that the seeming change of size is due to the same cause as the seeming change of size of molecules with temperature in the viscosity of gases and allied phenomena before the effects of cohesional force were allowed for in the kinetic theory of gases. The mathematical theory of the author is divided into three parts, dealing with three kinds of ions, a small one and two large ones. In his dynamical theory of the ions of gases the two new types of viscosity previously investigated for ions in electrolytic solutions are found to be of paramount importance.—*Phil. Mag.*, September.

Radium.—A paper by J. Joly deals with the radium contents of sea water, bringing out the very wide range of radio-activity at different points of the ocean. W. M. Watts calculates the atomic weight of radium from spectroscopic data by means of an interpolation formula. He finds it to be 226.5.—*Phil. Mag.*, September.

Units, Measurements and Instruments.

Standard Cells.—C. J. J. Fox.—A paper presented before the British Association for the Advancement of Science on a new and simple method of preparing mercurous sulphate for standard cells. There is no difficulty in purchasing Hg_2SO_4, which is quite free from foreign metals. If commercially pure Hg_2SO_4 be heated together with a little pure Hg and dilute H_2SO_4 for a day or so at from 120 deg. C. to 150 deg. C. in either a sealed tube (1-mm to 2-mm walled tubing) or bottle with wire-bound stopper, and occasionally agitated, a white crystalline preparation will be obtained even from a specimen of Hg_2SO_4 which is initially discolored almost black. The Hg_2SO_4 obtained in this way is itself free from nitrate; it is also quite free from basic salt. It is filtered off, ground up in a mortar with one or two successive quantities of diluted Hg_2SO_4, and then with several quantities of saturated cadmium sulphate solution; it is filtered off in a Büchner funnel after each washing. In this way it is possible with very little trouble to prepare quite large quantities of very reliable, well crystallized, white Hg_2SO_4 in every respect suitable for standard cells.—Lond. *Electrician*, Sept. 3.

Alternating-Current Galvanometer.—M. GUINCHANT.—A paper presented before the French Academy of Sciences. The measurement of resistance by the method of Kohlrausch becomes difficult when one of the arms of the bridge introduces a phase difference. A self-induction or a capacity insufficient to produce an appreciable difference between the ohmic and apparent resistances may produce parasitic sounds which will render the fixation of the minimum difficult. In a study of solid electrolytes the author has replaced the telephone by a galvanometer constructed as follows: A piece of iron is suspended by a silk thread in the center of two coils placed at right angles. One coil (with thick wire) is supplied with constant alternating current, the other (with thin wire) replaces the telephone. The first coil is placed perpendicularly to the magnetic meridian, consequently perpendicular to the piece of iron as directed by the magnetic field of the earth. The earth field is almost annihilated by an external magnet, so that the alternating magnetic field provides almost all of the directive force. Any alternating current of the same period passing through the coil of thin wire produces a field perpendicular to the first and gives a deflection to the piece of iron. The direction of the deflection is different according to whether the phase difference of the two coils is greater or smaller than 90 deg. In making bridge measurements one gets, thus (as with direct current), a deflection, the direction of which changes on passing through the equilibrium position. The value of resistance found by this measurement is the apparent resistance and not the ohmic resistance. The instrument operates equally well with direct current.—*L'Industrie Elec.*, Aug. 10.

Comparing Self-Inductance and Capacity.—C. H. LEES.—A mathematical paper on Vaschy's or Pirani's method of comparing the self-inductance of a coil with the capacity of a condenser.—*Phil. Mag.*, September.

Alternating-Current Instruments.—J. VON STUDNIARSKI.—The first part of a mathematical article illustrated by diagrams on the power consumption of alternating-current instruments.—*Elek. Zeit.*, Sept. 2.

Meter.—An official communication of the Reichsanstalt by which a direct-current motor meter of the Bergmann Com-

pany is admitted for calibration, its construction and method of calibration being described.—*Elek. Zeit.*, Aug. 26.

Oscillograph.—G. W. Smith.—An illustrated description of the principle and construction of the oscillograph.—*Jour. of Engineering*, University of Colorado, No. 5.

Calibration of Meters.—F. Orlich and G. Schulze.—An account of an investigation carried out in the German Reichsanstalt. The errors of electricity meters are generally determined with constant current, while in practice the meters are often subjected to varying load. The authors, therefore, investigated how far the errors found by calibration with constant current hold good also for varying load. They show theoretically that the readings of meters at varying load cannot be verified on account of the inertia of the movable system. These theoretical results are confirmed by tests of meters of three German companies.—*Elek. und Masch.* (Vienna), Aug. 29.

Telegraphy, Telephony and Signals.

Multiple Telegraphy.—E. Mercadier.—A paper presented before the French Academy of Sciences. The author, together with Magunna, has formerly shown that several telegrams can be transmitted simultaneously along the same line consisting of two wires by means of superposing alternating currents of different frequencies upon each other and also superposing at the same time direct-current impulses upon the different alternating currents. They have now studied whether the same results could be obtained with a line consisting of a single wire earthed at both ends. This experiment was made between Paris and Lyons. They were successful and could annihilate the effect of the earth currents at Lyons, where they are particularly strong. —*L'Industrie Elec.*, Aug. 10.

Microphone.—W. Muenchenhagen.—The author suggests the utilization of the fact discovered by Righi that a coil of bismuth wire changes its resistance in a varying magnetic field in such a way that the resistance increases with increasing field intensity. Instead of the copper coils, coils of bismuth wire are placed on the pole-shoes of the permanent magnet. The telephone changed in this way is used as a microphone. By speaking into it the vibrations of the iron diaphragm change the field intensity of the permanent magnet and therewith the resistance of the bismuth-wire coils. (It seems that the author has not yet made such an instrument.)—*Elek, Anz.*, Aug. 8.

Wireless Telephony and Telegraphy.—E. Nesper.—The conclusion of a long serial giving a review of the present situation of wireless telegraphy and telephony.—*Elek. Anz.*, Aug. 21.

Miscellaneous.

Canadian Development.—William N. White.—His address to Section G of the British Association for the Advancement of Science. The speaker first emphasized that the governing authorities of Canada have appreciated the fact that bold enterprise and generous financial provision are essential to the progress and prosperity of the country. He then gave a review of the great progress made in railway building in Canada. As to electric traction, he stated that in 1901 there were 553 miles of electric railways and 815 miles in 1907. He then took up the building of canals and the development of water-powers. It has been estimated that on the line from Lake Superior, through the chain of lakes and rivers leading to Niagara, and thence through the St. Lawrence to the sea, 11,000,000 hp may be developed. Langelier has estimated that in the Province of Quebec the water-power aggregates more than 18,000,000 hp; other provinces all possess large resources of the same kind as yet untouched.—Lond. *Electrician*, Aug. 27.

Educational.—The presidential address of Rev. H. B. Gray tc the Educational Science Section at the recent Canadian meeting of the British Association for the Advancement of Science His object was "to force upon the attention of English educationalists certain imperial factors which should occupy an indispensable place in the educational curricula of the great schools in the mother country." He would give a prominent piace to the scientific teaching of geography, and particularly to historical geography, with special reference, of course, to the origin, growth and progress of the British empire. He would enforce an elementary knowledge of science on every boy who passes through the stage of secondary education. But, above all, he urges the bringing into the foreground a co-ordinated study of English language and English literature. He criticises severely the old mediæval system of education which has prevailed in England till comparatively recent years, and thinks the time has come when the study of two ancient languages should be reduced to one for all except scholastic specialists. He emphasizes "the necessity of a closer touch educationally (in the sense of 'academically') between the secondary schools and colleges of the mother country and similar institutions in the great Dominion and commonwealths which own her parentage." He criticises severely the usual system of examinations. He recommends an interchange of university students among English-speaking peoples. He finally emphasizes "the importance of what the educationalists of the United States call 'civics' as the binding power which should fasten together all the separate educational faggots in any imperial scheme of education —the duty of personal service to the state, the positive obligation which makes us all members incorporate in one imperial system."—Lond. *Electrician*, Sept. 3.

Electric Welding.—The first part of an article giving a review of various electric welding apparatus of recent construction.—*Elek. Anz.*, Aug. 29.

Laboratory Appliances.—W. Ikle.—A long description of details of a great many useful appliances, such as supports, clamps, burners, pipes, etc., for use in a physical laboratory. Mention was made chiefly of such appliances as are not generally known.—*Phys. Zeit.*, Sept. 1.

British Universities.—An article giving particulars of the courses of instruction in electrical engineering which are given at the various British universities, colleges, technical institutes, etc. Particulars are given of the electrical engineering courses at Cambridge and Oxford, and the leading universities, colleges and technical schools in the provinces, indicating, where possible, the previous education expected, the length and nature of the course, the fees and the degrees or certificates that can be taken.—Lond. *Elec. Eng'ing*, Aug. 19. The universities and colleges in London are dealt with in Lond. *Elec. Eng'ing*, Aug. 26.

Autogenous Welding.—C. B. Auel.—An illustrated description of welding by means of the oxy-acetylene flame and its application to welding various metals, with special reference to the methods of oxygen and acetylene supply. Reference is also made to the cutting of metals by means of the oxy-oxy-acetylene flame.—*Elec. Journal*, August.

Logarithmic Curves.—M. U. Day.—The first of a series of articles on the use of exponential and logarithmic functions as employed in connection with problems of self-induction of magnets, acceleration of armatures, etc.—*Gen. Elec. Review*, September.

Reichsanstalt.—A translation of the recent German report, already noticed in the Digest, of electrical work at the German Reichsanstalt in 1908.—Lond. *Electrician*, Aug. 27.

BOOK REVIEW.

Switchboard Measuring Instruments. By John C. Connan. New York: Spon & Chamberlain. 150 pages, 117 ills. Price, $2.

This volume deals with the design and construction of direct-current and alternating-current switchboard instruments, the substance having been collected by the author from various sources. Exact information of any particular make has been avoided and only meager details of construction are given. The treatment is far from lucid, and the equations and principles given are often confusing owing to a mixture of symbols; C, for instance, representing current in one case, a constant in another and capacity in another. The types of meters chosen are principally from foreign markets so that the text does not reflect American practice.

NEW APPARATUS AND APPLIANCES

Metal Reflector for Incandescent Lamp.

Fig. 1 herewith shows the application and Fig. 2 gives the distribution curve of the "Radio" reflector built by the Radio Reflector Company, of New York, and intended for incandescent electric lamps. The device is made of steel and given a polished nickel finish on the inside or corrugated reflecting surface. The

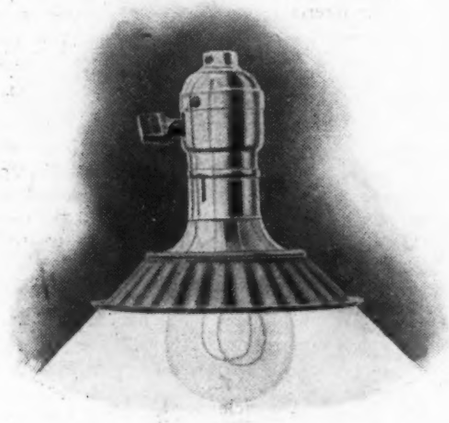


FIG. 1.—RADIO REFLECTOR ON LAMP.

diameter of the lower portion is 5 in. and the depth of the shade about 1 in. The upper part of the reflector is built on the iris-diaphragm principle so that the shade can be adjusted to any incandescent lamp in any place and any position without a shade holder. It is merely slipped over the lamp and remains where placed. The curve shows that the greatest amount of

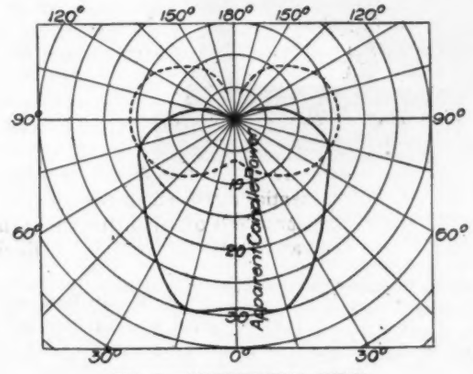


FIG. 2.—DISTRIBUTION CURVE.

light is obtained at an angle of about 15 deg., the candle-power ranging from about 1 cp at 120 deg. to 30 cp at 15 deg. The results plotted in the curve show the light obtained with and without the reflector in apparent candle-power at 10 ft.

The Western Electric Sign.

The Western Electric Company will within a few months mount on the sideboards of all trucks used by its various houses in the United States its striking sign. The sign is the well-known "Consult the Map" trade escutcheon of the company, but will in each location bear the address of the local house instead of the phrase "Consult the Map." The signs are black, the lettering being embossed and silver leafed. The wholesale labeling of the hauling and delivery departments of the company signalizes the rounding out of the company's wide-sweeping advertising campaign.

Electric Vulcanizers for Automobile Tires.

The vulcanizing of pneumatic tires requires for good work a steady heat at a predetermined temperature. Electrically heated vulcanizing apparatus with proper thermostatic control is nearly an ideal apparatus because it does not require the skill in operation required by flame-heated vulcanizers, is small and easy to apply, and is much more likely to give definite and satisfactory results, owing to the positive control of the heat. The C. A. Shaler Company, of Waupun, Wis., makes two types of electric vulcanizers for automobile tires. One of these is for alternating current only, and the other has a rheostat control and can be operated on alternating or direct current. They are both portable and can be taken in the automobile tool box and used wherever electric lighting current is available by plugging into any lamp socket. For use in garages they do away with the uncertainty and fire risk of flame-heated vulcanizers.

110,000-Volt Porcelain Insulator.

The suspended type of high-tension insulator shown in the accompanying cut has been developed and placed on the market by the Ohio Brass Company, of Mansfield, Ohio. This insulator is the one recently chosen by the Hydroelectric Power Commission of Ontario for operation on its transmission line at 110,000 volts.

HIGH-TENSION INSULATOR.

The design of the lower surface of each porcelain shell is such as to confine the static discharges to an area immediately surrounding the forged stud, until the voltage impressed has approached that of flash-over. The operation of the insulator is exceedingly quiet up to flash-over. The electrostatic capacity is small, as each unit consists of a single porcelain shell (in place of several shells), a malleable iron cap and forged steel pin. The mechanical breaking strain of this insulator is approximately 10,000 lb., which allows ample factor of safety for normal conditions. The weight of each unit complete, with cap and forged stud, is 10¼ lb., and when assembled the distance between the edges of adjacent porcelain shells is 6¼ in. The length of two assembled units, from center of eyes in top unit to lower edge of forged pin in lower unit, is 13 9/16 in., and each unit added increased the length by 6¼ in.

Each assembled unit tested dry will flash over at approximately 95,000 to 100,000 volts, and under a heavy precipitation of 0.3 in. to 0.4 in. of water per minute, at an angle of 45 deg., will flash over at approximately 50,000 volts to 55,000 volts, and when tested under oil, punctures at approximately 120,000 volts to 150,000 volts. Each insulator is tested to 6000 lb. before packing and is given a flash-over test after the mechanical test, which is in addition to a severe electrical test, before assembling. In an assembled condition of two units, with a separation between the porcelain shells of 6¼ in., the flash-over dry is approximately 175,000 volts, and each unit

added increases the flash-over approximately 75,000 volts; two units under 0.3 in. to 0.4 in. precipitation per minute, flash over at approximately 110,000 volts, and each additional unit increases the flash-over by approximately 45,000 volts. The insulator is known as the "O. B. Hi-tension porcelain insulator."

Improvements on High- and Low-Head Water Turbines.

In the accompanying illustrations, Fig. 2 shows a new "scroll-type" high-head turbine made by the Trump Manufacturing Company, of Springfield, Ohio. This turbine has been designed for heads ranging from 20 ft. to 400 ft., and is so designed that the water is guided to the turbine runner in uniform rotary motion, which is obtained by a special construction

FIG. 1.—LOW-HEAD TURBINE.

of the crown plate of the turbine proper. This crown plate is cone shaped with spiral vanes cast on it. The water is delivered onto the turbine parallel to the shaft. Where water is delivered to a turbine at right angles to the discharge, or at right angles to the shaft passing through the turbine, there is more or less eddying, and more or less indirect pressure on one side of the turbine casing, the result being that the water enters the gates direct on one side and indirect on the opposite side. This objectionable feature has, it is claimed, been eliminated from the turbine illustrated.

The gate mechanism in this wheel and the gates are made of phosphor bronze, and are operated by a ring passing entirely around the outside of the water-wheel casing proper, or, in other words, around the periphery of the gates, and is so constructed that the gates are operated without the use of any link connections, which, in practice, have been found to be a continuous source of trouble, and in which there is always more or less lost motion.

The end thrust in this type of turbine has been eliminated through the use of the Trump patented water cushion, which is claimed to be practically frictionless, and is automatic in its operation. Through the use of the water cushion no wooden thrust blocks or other mechanical thrust bearings are required.

In Fig. 1 is shown the horizontal draft-chest type of Trump turbine for open penstock setting. This has been designed for use under low heads, where it is preferable to use the horizontal rather than vertical setting, which latter, as a rule, necessitates the transmission of power through bevel gearing. The turbine illustrated is 44 in. in diameter, and was designed to operate under a head as low as 9 ft. These turbines have been brought out and are manufactured by the Trump Manufacturing Company, Springfield, Ohio.

Exhibits at the Vermont Electrical Association Convention.

There was quite a large attendance of manufacturing and supply representatives at the convention of the Vermont Electrical Association, a report of whose proceedings is given elsewhere.

General Electric Company made a small but interesting exhibit of its complete line of tungsten lamps, and also used a number for illustrative lighting of the Armory in which the sessions were held. It was represented by Messrs. F. W. Willcox, T. J. Brown, H. W. Brown, R. B. Hampson, J. S. Butler, D. G. Brokaw, A. W. Ives, Chas. Burleigh, H. Schroeder, W. J. Newcomb, J. Starr Button, C. H. Scott, W. M. Watkins.

Westinghouse Electric & Manufacturing Company was represented by Messrs. G. M. Bates, C. P. Wahn, A. F. McCarthy and I. P. Sprague. A number of excellent posters about the hotel called attention to the nature and quality of the company's apparatus. Mr. H. P. Childs was present on behalf of the Westinghouse Machine Company.

Mr. C. F. Gilliatt made a very interesting exhibit in full operation of the instrument now being put on the market by the Excess Indicator Company, of Lynn, Mass.

Holophane Company was represented by Messrs. V. R. Lansingh, C. Walter Jones, W. F. Miner and H. C. Jones. The address of Mr. Lansingh on illumination education created a most favorable impression, and led to a great deal of inquiry as to "how to be saved" from wasteful methods in the future.

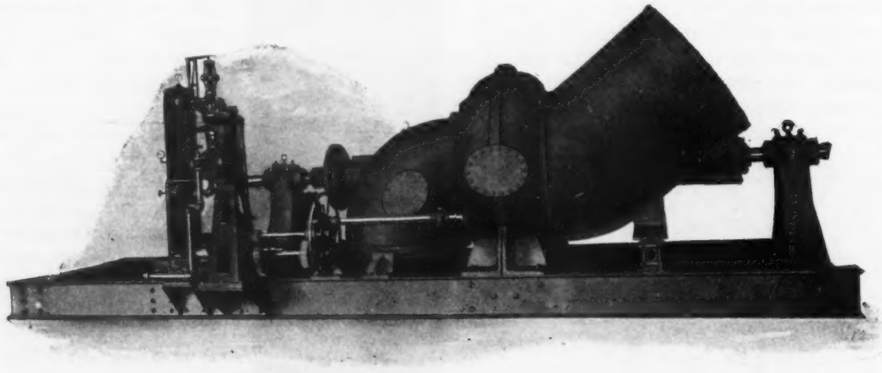


FIG. 2.—HIGH-HEAD TURBINE.

Miscellaneous representatives were as follows: W. H. Merrill, Edwin C. Lewis Company, Boston; Harvey Bozarth, Fort Wayne Electric Works; F. L. Mullock, S. P. Thieman, Stuart-Howland Company; D. F. Beattie, Fairbanks Company, Albany, N. Y.; T. P. Bedford, Electric Storage Battery Company; W. J. Griffith, John A. Roebling's Sons Company; H. W. Savage, H. P. Brown, Wetmore, Savage Company, Boston; N. I. Allen, Jr., McKinney & Waterbury Company, Boston; H. H. Russell, Vulcan Electric Heating Company; R. P. Smith, Lombard Governor Company; Joseph Couilliard, New England Insurance Exchange; P. G. Detweiler, Franklin Electric Manufacturing Company; W. F. Abely, C. F. Howes, Western Electric Company; W. F. Peterson, Pettingell-Andrews Company; John J. Myer, American Circular Loom Company; H. P. Moore, Chase-Shawmut Company; M. Falk, T. C. Sias Company, Boston; F. Booth, L. Kemper, H. T. Paiste Company; H. E. Stover, Stackpole Battery Company, St. Mary's, Pa.; R. P. Ingalls, Simplex Electric Heating Company; E. E. Larrabee, W. S. Kilmer, Green Mountain Electric Company, Burlington; T. C. Martin, *Electrical World*.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Reports from every branch of trade during the past week were so much improved that it might not be out of line to call them enthusiastic. From all parts of the country, especially from the Central West and the Mississippi Valley, there is reported large commercial and industrial advancement. Wholesalers and jobbers throughout the central section are doing an extremely satisfactory business, collections have very materially improved, and retailers report a larger trade than at any time within the past two years. Satisfactory reports also are received of the crop condition, and, while there will be no bumper yield, the turn-over of the producers will be large, and the prices received therefor will be higher than usual. Even in the South, where the shortness of the cotton crop has caused some disturbance, the advance in prices has offset to a large degree the ill effects of a small yield. One feature of the crop situation is the rapidity with which it is being moved to market. This is reflected in the railroad reports, and the list of idle cars is rapidly decreasing. In fact, some railroads have reported within the past week that at this time they had no good-conditioned cars which were not in service. The industrial situation continues to expand, and especially in the iron and steel industries the mills are kept busy. In many places prompt deliveries are being refused. During the past week heavy orders for steel rails have been received, which practically insures active operation of the rolling mills for months to come. The demand for structural material is a trifle quieter than earlier in the season, but there are many deliveries yet to be made. In the electrical industry the activity is not as marked as in other branches of the metal trade, but all of the big electrical concerns are doing a fair business, especially in small apparatus. Business troubles are not numerous; the number for the week ended Sept. 16, as reported by *Bradstreet*, were: 198 against 191 the week previous; 266 in the same week in 1908; 197 in 1907; 171 in 1906, and 173 in 1905.

THE COPPER MARKET.

Although there has been but little actual business done in the copper market during the past week prices have remained firm and are slightly higher. In addition to this there is a distinctly stronger tone and evidence that preparations are being made to put prices up through the instrumentality of manipulation in the London market. This will probably not be a difficult matter as the reduced exports last month have had the effect of limiting the increase in the visible stocks abroad. It is estimated that on Sept. 15, the foreign visible was 202,473,600 lb. It is said, as indicating an advance, that the lots of copper held by second hands, both here and abroad, which were pressing for sale a few weeks ago, have been taken up, thus relieving the market of a demoralizing influence. It is also said that manipulators on this side have sent buying orders to London for the purpose of strengthening the domestic market and possibly inducing a buying movement from actual consumers. It is hardly probable that these tactics will be conspicuously successful. The consumers are not uninformed about the actual conditions of the market and have little faith in the legitimate advance of prices. Many actual melters have already on hand considerable stocks and are not inclined to purchase except at bargain prices. Production continues at record rate and this is also well known by the actual users of copper. Exports continue to be rather light. Since the beginning of the month, including Sept. 20, they have been 10,508 tons. The daily call on the Metal Exchange, at 12:30 o'clock Sept. 20, quoted standard copper as follows:

	Bid.	Asked.	Settling price
Spot	12.50	12.65	.....
September	12.50	12.65	12.57½
October	12.50	12.75	12.62½
November	12.50	12.75	12.62½
December	12.50	12.85	12.67½

The London prices Sept. 20 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	58 17 6	59 0 0
Standard copper, futures	59 15 9	59 17 6
Market.	Steady.	Firm.
Sales of spot		300 tons
Sales of futures		900 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.00	12.62½
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6

EMPIRE DISTRICT ELECTRIC COMPANY.—The Empire District Electric Company, the new holding concern organized by H. L. Doherty & Company, to take over the several plants in the neighborhood of Joplin, Mo., which that firm recently acquired, has let contracts for its new power station at Riverton, Kan., which is only a few miles from Joplin. The contracts were made with the Westinghouse Electric & Manufacturing Company for two 6000-kw steam turbines and for the necessary switchboards and transformers. The current will be generated at 6600 volts and stepped up to 33,000 volts for transmission. There will be 15 substations throughout the district, and the energy will be delivered to customers at 2300 volts. A contract has also been let to the Babcock & Wilcox Company for Stirling boilers. The new plant will be in operation early in 1910, and will be used as additional and auxiliary to the several water-power plants already in operation.

MORE HUDSON TUNNEL TRAINS.—The Hudson & Manhattan Railroad Company has put on a service through the Hudson River tunnels of a minute and a half headway during the rush hours. Heretofore the trains have been running at two and a half minutes headway, and the service could not be improved on account of the shortage of equipment. In speaking of its plans, a representative of the company said that the recent publication that it was contemplated to extend the railroad out into New Jersey and eventually to Philadelphia was absolutely absurd. He said that Newark was the farthest point in New Jersey that was considered at present by the railroad's managers, and Newark would be reached from Jersey City over the Pennsylvania Railroad tracks. The company still has under consideration the plan for building a tunnel from the Pennsylvania station in Jersey City to the station of the Central Railroad of New Jersey in Communipaw.

WESTINGHOUSE STORAGE BATTERY COMPANY.—Reports from the Westinghouse Storage Battery Company, the newly organized concern which took over the battery department of the Westinghouse Machine Company and also the General Storage Battery Company, are to the effect that orders are very plentiful, and that the plant at Boonton, N. J., is as busy as it could well be. The work of amalgamating the working forces of the two concerns is practically completed, but it is said that there will be no change in the personnel of the management of the new company from that announced in our issue of Aug. 12.

NEW CALIFORNIA WATER-POWER PROJECT.—J. H. Logan, of Santa Cruz, Cal., has filed notice of an appropriation of 250,000 cu. in. of water in the Pitt River, California, near the mouth of the Burney River. This water is to be conveyed a distance of 30 miles through a canal and tunnel, the tunnel, under a mountain range, being six or seven miles in length. When the water-power plant is completed it is estimated that it will be capable of developing 400,000 hp. It is said also that the water will be available below the power plant for the irrigation of lands in the upper Sacramento Valley.

BALTIMORE & OHIO ELECTRIC LOCOMOTIVES.—Among a lot of equipment recently ordered by the Baltimore & Ohio Railroad Company were two electric locomotives from the General Electric Company. These locomotives, it is said, will be for use in the Baltimore tunnel, and will be similar to those now in service at that terminal.

INSULATED WIRE CONTRACTS.—The Habirshaw Wire Company has been awarded contracts for "Red Core" insulated wire for the interior of the New Theater, New York; Gimbel Brothers' department store, New York, and the new City Hall, Chicago.

MONTGOMERY (ALA.) CITIZENS' LIGHT, HEAT & POWER COMPANY.—Mr. Fred. S. Ball, attorney and counsellor, Montgomery, Ala., calls our attention to what he states are errors in a note entitled "Bond Issue Enjoined," which appeared in these columns in our issue of Sept. 9, page 634. He says: "The statement that 'a temporary injunction has been issued' is incorrect, as nothing but a preliminary restraining order was issued, and the defendant was given the right to move for its dissolution on the same day. That restraining order was not against the Citizens' Light & Power Company, but against the Citizens' Light, Heat & Power Company. It is stated that the action 'was brought by Daniel A. Cullinam, a stockholder.' The bill filed is not against the Citizens' Light & Power Company at all, but against the Citizens' Light, Heat & Power Company, and the complainant stated only in ambiguous terms that he held the 'legal title' to one share in the latter company and that he was not otherwise interested, except as the holder of certain voting trust certificates representing shares in the Citizens' Light & Power Company, a 'holding company,' owning the stock of the Citizens' Light, Heat & Power Company. The restraining order was issued on Aug. 28 and upon argument promptly dissolved and the preliminary injunction absolutely denied on Sept. 2. The same publication refers to a suit brought by C. E. White, which has been pending ever since last May, to which demurrers interposed by the company were promptly sustained, and after amendment demurrers were again filed and submitted and the decision has not yet been made by the court. That suit is not brought by White as a stockholder, but as a relator, nor does it allege that the Citizens' Light, Heat & Power Company was 'the predecessor of the present company;' on the contrary, it admits the legal existence of the Citizens' Light, Heat & Power Company, and attacks the formation of the Citizens' Light & Power Company. Even if that action was successful, it could not affect the Citizens' Light, Heat & Power, which owns the plant, operates the business, and has issued the bonds referred to in the other suit."

LORD ELECTRIC COMPANY CONTRACTS.—The Lord Electric Company, of New York, has been awarded contracts for the roadways, railings, lamp brackets and wiring of the new Manhattan Bridge across the East River. These contracts embrace the construction of a roadway of creosoted wooden blocks and of two sidewalks to be made of concrete and artificial stone. Along these ways there are railings with ornamental posts. There will be six of these railings on the lower deck of the bridge and four on the upper deck. The bridge will carry eight tracks, four for trolleys and four for third-rails. The company will also do the entire wiring for the lighting and traction work on the bridge. This includes the wiring and bonding of the four tracks on the lower deck. The lighting equipment, which is a portion of the contract, includes ornamental brackets for both arc and incandescent lights, and the fixtures for the latter. There are 54 of these arc brackets and 198 incandescent. The company will also construct two switchboards, one on each end of the bridge. It is proposed that the energy for lighting will be divided midway of the bridge between the Manhattan and Brooklyn Edison companies. All this work is expected to be completed by Dec. 15, as it is now proposed to have the bridge ready for opening in January.

MILLION-DOLLAR ARC CARBON PLANT.—The Wilckes-Martin-Wilckes Company, the largest manufacturers and dealers in lampblack in this country, has prepared plans for the construction of a large manufactory for lighting carbons. A new company is to be organized with a capital of $1,000,000, which, it is promised, will go into the manufacture of all kinds of lighting carbons. Definite plans of the new company cannot be fully stated at this time, but will be ready for publication within a few weeks. Mr. Wilckes in speaking of the new enterprise said that he thought the field was a promising one for the investment of capital, and that as he was already in the lampblack business he felt that a good market for this product would be found in the manufacture of carbons. He said it is the intention of the new company to make all kinds of high-grade lampblack carbons, including flaming-arc, searchlight, moving-picture and enclosed-arc carbons, and in addition to this to manufacture the ordinary petroleum coke carbons, which are still used to a considerable extent in street lighting. He said that he was not ready to announce the location of his plant, but that several pieces of real estate had been tentatively looked over, and that the plant when constructed would be in every way up to date.

MUNICIPAL ELECTRICAL PLANT FOR MILWAUKEE.—Hering & Fuller, consulting engineers, of New York, have submitted to the city of Milwaukee an estimate of the cost of building a generating station in connection with the garbage crematory which is now in operation. This crematory was built by Hering & Fuller, and the steam generated in the destruction of the garbage will be used to generate energy. The plans submitted provide for sufficient power to generate 500 kw, and the cost of such an installation is figured to be about $60,000. The firm suggests that this energy be used for pumping, lighting or for power in the sewage pumping station.

GENERAL ELECTRIC CONTROLS BERGMANN TUNGSTEN PATENTS.—A deal has been made between the General Electric Company and the Bergmann Electric Works, of Berlin, by which the latter has sold to the former all of the American patent rights covering its tungsten lamps for a period of 10 years. The Bergmann company will not establish a lamp factory in this country as proposed, and the Bergmann lamp will not be imported except under license of the General Electric Company within that period. This following upon the acquirement by the General Electric Company of the Just and Kusel patents practically gives that company a strong grasp of the tungsten lamp situation.

PENNSYLVANIA TUNNELS OPENED.—The officials of the Pennsylvania Railroad Company have issued a statement correcting the impression that the East River tunnels would be opened to the public before the end of the year. It is stated that these tunnels will probably be used in December for the operation of construction cars, and that it may be possible that by February, 1910, passenger trains will be running to some sections of Long Island. The new station, however, will not be completed until May or June, and full service from the East and from the West will not be attempted before that time.

STORAGE BATTERY "SMOKER."—The Electric Storage Battery Company, through Mr. Godfrey H. Atkin, manager of the Chicago office, has issued invitations to a smoker to be held at the rooms of the Western Society of Engineers, Monadnock Building, Chicago, on the evening of Sept. 23. Mr. H. M. Beck, one of the engineers of the company, will give an illustrated talk on "Care and Operation of Storage Batteries." A supper will be served after the meeting.

NEW PUMPING PLANT FOR CHICAGO.—Plans have been prepared for installing two new pumping engines in the Roseland power station at Chicago with a capacity of 50,000,000 gal. per day. It is expected to have the new pumps in operation within a year. These pumps will be operated by electricity. Energy will be furnished by the Sanitary District of Chicago, and the Commonwealth Edison Company will be prepared to furnish an emergency service.

NIAGARA FALLS CONTRACTS.—The John A. Roebling's Sons Company has received the contract for cable to transmit electric power for pumping from the works of the Niagara Falls Hydraulic Power & Manufacturing Company to the new city pumping station. The order is for 18,000 lin. ft. of cable. The J. Ellwood Baird Company, of Buffalo, will supply and install 18,000 ft. of 4-duct conduit.

CATALOGS WANTED.—Sanford & Cia, Monterey, N. L., Mexico, dealers in mining machinery and supplies, including electrical apparatus and material, write that their establishment was completely destroyed by fire several weeks ago, and that they would like catalogs and price lists from manufacturers of electrical equipment of all kinds.

EXTENSION OF ELECTRIC POWER IN REMINGTON FACTORY.—Owing to increase of business it has become necessary for the Remington Typewriter Company to enlarge the capacity of its factory at Ilion, N. Y., and orders are to be placed for an additional power unit and for machine-tool equipment amounting to about $50,000.

FORT WAYNE ELECTRIC COMPANY.—The business of the Fort Wayne Electric Company, Fort Wayne, Ind., has recently assumed such proportions that the regular force is inadequate and the company is advertising for labor, which is needed in every department.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in the present issue are announcements of proposed new plants or considerable extensions of present plants at Carson City, Nev.; Mandeville, La.; Dayton, Ohio; Colville, Wash.; Sebastopol, Cal.; Cosmopolis, Wash.; Ryan, Okla.; Moline, Ill.; Clifton, Ohio; Iowa City, Ia.; Thurmont, Md.; Brownsville, Pa.; Cuyahoga Falls, Ohio; Floydada, Tex.; Le Suer, Minn.; Plaistow, N. H.; Gloversville, N. Y.; Alexandria, La.; Santa Rosa, Cal.; Fresno, Cal.; Fort Meyer, Va.; Tyndall, S. D.; Richwood, W. Va.; Omaha, Neb.; Marshall, N. C.; Erie, Kan.; Lake Charles, La.; Elmira, N. Y.; Port Byron, N. Y.; Glasgow, Mo.; Durant, Okla; Wells, Mich.

ANOTHER NEWFOUNDLAND CABLE.—Upon the return from Europe last week of George Gray Ward, vice-president of the Mackay Companies, announcement was made that the Commercial Cable Company would cut into Newfoundland another one of its Transatlantic cables sometime during the fall. Last summer one of the cables running from England to Nova Scotia was tapped 270 miles east of St. Johns, N. F., and carried to that port, a new cable being laid from St. Johns to New York. It is now the purpose of the company to do the same thing with a second cable.

STANLEY EMERGENCY HOSPITAL.—The Stanley G. I. Manufacturing Company is erecting at Pittsfield, Mass., a building 40 x 60 ft., three stories high, of reinforced concrete, which will be used as a garage, emergency hospital and quarters for the Stanley fire brigade.

Financial Intelligence.

THE WEEK IN WALL STREET.

The New York stock market during the past week has been one of considerable activity, extreme strength of tone and advancing prices. The settlement of all the Harriman uneasiness, by which the stock market has been unnecessarily alarmed, merely means that the interests that Harriman dominated will continue in the same line in which they have been operated for the past several years. The selection of Judge Lovett to the leading positions on the Union Pacific and Southern Pacific boards, and the selection of Kuhn, Loeb & Company, as representatives, means that the Harriman policies are to be carried out. Exactly what the Harriman policies were has never been disclosed, but the present changes mean that the Harriman policy of advancement will certainly not be set backward. This has been reflected in the stock market during the past week by the steady advance in prices, and the general strength of the issues in which Mr. Harriman was interested. Other issues have been correspondingly strong, especially United States Steel, which during the week reached the top price of 84¾, the highest since the stock was issued. The whole market in Wall Street is strong, and every issue that shows any indication of earning dividends is advancing in price. Even Amalgamated Copper, which at the present price of the red metal is not a very inviting proposition, advanced during the week between five and six points. All of the industrials that are connected with the iron and steel trade show reasonable advances, and the traction stocks, which have for a number of weeks been almost dormant, were relatively strong. It is hardly proper to say that these advances are speculative. The industrial condition of the country warrants advances, and, while the prices of stock have been recognized generally to be higher than conditions warranted, it is not remarkable that further advances were made when business so materially improved. The bond market is hardly as active and strong as it has been when stocks were less active; money has been in greater demand, and loans have been more freely made. On Sept. 20 quotations were: Call 2¾ @ 3 per cent, 90 days 3¼ @ 4 per cent. The quotations in the table are those of the close Sept. 20.

NEW YORK.

	Sep. 13.	Sep. 20.	Shares sold.		Sep. 13.	Sep. 20.	Shares sold.
All.-Ch.	15⅜*	15⅜*	4,600	Int.-Met., pfd.	46	48⅛	19,510
All.-Ch., pfd.	51	54*	4,300	Mackay Cos..	80¾*	88½	3,300
Amal. Cop...	78¾	84½	235,075	Mackay Cos..p.	74*	75½	330
Am. D. T....	20½*	20½*	——	Man. Elev....	141½	143¾	235
Am. Loc.	59	61	12,400	Met. St. Ry..	20*	20*	——
Am. Loc., pfd.	115	118½	870	N.Y.&N.J. Tel.	139¼*	139¼*	——
Am. Tel.&Cbl.	83½*	84¾*	300	Steel, com....	78½	84	909,740
Am. T. & T..	141½	143	57,980	Steel, pfd....	124¾	128¼	29,961
B. R. T.....	76⅜	80⅛	61,800	W. U. T.....	79	78¾	49,301
Gen. Elec....	164	167¾	5,000	West'h, com..	84½	87	8.000
Int.-Met., com.	14½	14⅞	3,850	West'h, pfd..	130*	130*	——

PHILADELPHIA.

	Sep. 13.	Sep. 20.	Shares sold.		Sep. 13.	Sep. 20.	Shares sold.
Am. Rys.....	46	46	——	Phila. Elec.....	12¾	12½	——
Elec. Co.of A.	12⅛*	12¼*	——	Phila. R. T...	30*	27	——
Elec. St. B'ty.	62	62	——	Phila. Trac....	91⅛*	88½*	——
E. S. B'ty,pfd.	30*	30*	——	Union Trac...	54	52¾	——

CHICAGO.

	Sep. 13.	Sep. 20.	Shares sold.		Sep. 13.	Sep. 20.	Shares sold.
Chi. City Ry..	180*	180*	——	Chi. Tel. Co..	135¼*	138*	——
Chi. Rs.,Ser.1.	110*	110*	——	Met. El., com..	15⅛	16	——
Chi. Rs.,Ser.2.	36¾	36¾*	——	Met. El., pfd..	49	49½	——
Com. Edison..	120½	120	——	Nat'l Carbon..	96¾	96¾	——
Chi. Sub'ws...	10½	9⅛	——	Nat'l C., pfd..	119¼*	118½*	——

BOSTON.

	Sep. 13.	Sep. 20.	Shares sold.		Sep. 13.	Sep. 20.	Shares sold.
Am. T. & T...	141½	143⅜	——	Mex. Tel.....	2¼*	3*	——
Cum. Tel.....	145*	145*	——	Mex. Tel., pfd.	6*	6	——
Edison E. Ill..	255	252	——	N. E. Tel.....	134*	139	——
Gen. Elec.....	164¼	168	——	W. T. & T....	10⅞	11	——
Mass. E. Ry..	16	17*	——	W. T. & T., p.	89*	90	——
Mass. E. R.,p.	77½	79½	——				

* Last price quoted.
Shares sold are for week of Sept. 13 to Sept. 18.

PHILADELPHIA RAPID TRANSIT COMPANY.—The annual report of the Philadelphia Rapid Transit Company for the year which ended June 30, 1909, shows gross earnings of $18,317,529, which is a gain over 1908 of $17,449. The operating expenses were $9,364,737, a reduction over the previous year of $429,769. The improvement in net earnings which was thus brought about has been more than offset, however, by the increase in charges, and the fiscal year ended with a deficit of about $132,221 more than that of 1908. At the annual meeting, John B. Parsons, who resigned as president of the company, was elected chairman of the board of directors, and Charles O. Kruger was chosen president. The following resolution of regret at Mr. Parsons' retirement was adopted: "Resolved, That, in view of Mr. Parsons' insistence upon retiring from the presidency, the board desires to express its high appreciation of his long and devoted services to the company, and his unfailing courtesy to and co-operation with the board as president of the company, and further to express its satisfaction that he will remain as chairman of the board." In addition to electing Mr. Kruger president, the board also elected the following officers: First vice-president, Clarence Wolf; second vice-president, Alexander Rennick; secretary and treasurer, R. R. Selfridge; assistant secretary, James J. Springer; assistant secretary and treasurer, A. D. Hallman. The directors also announced that Drexel & Company have been selected as the fiscal agents of the company.

GENERAL MOTORS COMPANY INCREASE. — An amendment has been filed at Trenton to the charter of the General Motors Company, increasing its capital stock from $12,500,000 to $60,000,000. The stock is to be divided into $20,000,000 preferred, bearing 7 per cent cumulative, and $40,000,000 common. The General Motors Company is the holding company which has taken over several large automobile manufacturing concerns, and which it is said has in contemplation the absorption of several more. It was incorporated in September, 1908.

PAWLING (N. Y.) ELECTRIC LIGHT, HEAT & POWER COMPANY.—The Public Service Commission of the Second District has authorized the Pawling Electric Light, Heat & Power Company to issue 800 shares of capital stock at $25 per share, and to construct a plant and operate in the village of Pawling, Dutchess County, N. Y.

CATARACT POWER & CONDUIT COMPANY.—The Cataract Power & Conduit Company, of Buffalo, has been authorized by the Public Service Commission of the Second District to issue $154,000 5 per cent bonds, to be sold at not less than 95, to be used for extensions and the payment of $4,000 of present indebtedness.

CLEVELAND RAILWAY COMPANY'S DEBT.—The United States Court has granted an order allowing the receiver of the Cleveland Railway Company to use $600,000 out of the street car funds to pay floating debts. An order has also been made providing for the purchase of 25 new cars.

GETTYSBURG (PA.) TRANSIT COMPANY.—C. F. Kraft, of Philadelphia, representing the Central Trust Company, has purchased at foreclosure sale the property of the Gettysburg (Pa.) Transit Company. The price paid was $60,000.

WESTERN UNION TELEPHONE STOCK SOLD.—A deal has been made by which the Western Union Telegraph Company will sell to the American Telephone & Telegraph Company its holdings in the New York Telephone Company, amounting to about $16,000,000 par value. The New York Telephone Company is regarded as one of the most important subsidiaries of the American company, which owns, since the acquirement of the Western Union holdings, all but about $2,000,000 of the $50,000,000 capital stock. The deal was made through Kuhn, Loeb & Company, and will bring the Western Union about $25,000,000. In this connection it is said that the capital of the New York Telephone Company is to be increased from $50,000,000 to $100,000,000. This increase is to be made in order to allow the New York company to take over all the other Bell companies now operating in New York territory. Of the Western Union holdings some $9,733,100 had been pledged as collateral for $10,000,000 series "A" Western Union convertibles, which cannot be called for payment before May 1, 1912. It is said that the remainder of the Western Union holdings had only been half paid for. This transaction is said to have nothing to do with the settlement of the suit which has long been pending between the Western Union and the Bell company, and which was recently decided in favor of the former. There are still rumors in Wall Street to the effect that the American Telephone & Telegraph Company is endeavoring to acquire control of the Western Union, but no official statements have been made. It is said that the holdings of George J. Gould and of the late Russell Sage have actually been transferred to the American company. This report could not be confirmed at the office of either corporation. It is recognized that the rights-of-way now possessed by the Western Union Telegraph Company would be of great value to the telephone company.

PUBLIC SERVICE CONSOLIDATION AT MONMOUTH, ILL.—The Monmouth Public Service Company, of Monmouth, Ill., has been organized, and has purchased the capital stock and property of the Monmouth Gas & Electric Company, of which Mr. William Mainland, of Oshkosh, Wis., was president, and Mr. W. J. Ferris, of LaCrosse, Wis., vice-president. The officers of the new company are: President, Mr. W. H. Schott, Chicago; vice-president, Mr. F. W. Harding, Monmouth; secretary, Mr. J. W. Clendening, Monmouth; treasurer, Mr. W. D. Brereton, Monmouth. These gentlemen, with Mr. Fred E. Harding, will compose the first board of directors. The capital stock of the old company was $200,000, and there was a bonded indebtedness of the same amount. The capital stock of the new company will be $600,000, with a bond issue of $400,000. The Monmouth Public Service Company will take over the J. F. Searles plants and franchises, and will operate the ice plant now controlled by these interests. In addition, a district steam heating plant will be established, and it is promised that it will be ready for business early in November. Extensive improvements will be made on all the plants now in operation. New boilers and machinery will be installed in the electric light plant, and there will also be betterments in the plant and mains of the gas department. The company will be prepared to furnish electricity, gas, heating and refrigeration, so that its list of public service utilities will be comprehensive, justifying its name. It is said that a few large factories will give it a connected load of 2000 hp. The Schott Engineering Company, of Chicago, will do the engineering work.

ANOTHER WIRELESS TELEGRAPH SUIT.—Suit has been begun in the United States Circuit Court of New York by W. Scott Sims, the inventor of the Sims torpedo and other electrical devices, against the United Wireless Telegraph Company, the International Telegraph Construction Company, C. C. Wilson and Henry Schoemaker. Mr. Wilson is president of the United Wireless company and Mr. Schoemaker is chief consulting engineer. The suit alleges a conspiracy in violation of the Sherman anti-trust act. Mr. Sims asserts that the International Telegraph Construction Company, in which he is a stockholder to the extent of 125 shares, has been deprived of its business and is about to be put out of existence by the United Wireless Telegraph Company, which owns a controlling interest in it. This suit is an outgrowth of the one referred to in our issue of Sept. 16, in which a receiver for the International company was asked for. It is understood that the United Wireless Telegraph Company is anxious to wind up the affairs of the International company, and measures taken for this purpose are the basis of Mr. Sims' suit.

ALBION (N. Y.) POWER COMPANY SOLD.—The property of the Albion Power Company, at Albion, N. Y., which includes the plant of the Brockport Electric Company, which is owned by the Albion company, have been sold under foreclosure proceedings brought by the People's Bank & Trust Company, of Passaic, N. J., to Lucien H. Tyng, of Philadelphia, who represented the committee of bondholders. The purchase price was $38,250 and the assumption of the outstanding indebtedness, which amounted to about $120,000. It is understood that the property is to pass into the hands of the A. L. Swett Electric Light & Power Company, of Medina, N. Y. The plant and holdings of the Middleport (N. Y.) Gas & Electric Company, which also belonged to the same interests that owned the Albion Power Company, were sold to George F. Thompson, of Middleport, and it is understood that this property also will pass into the hands of Mr. Swett. It is understood that the Swett company at Medina will connect its transmission lines with the lines of the Albion and Brockport plants.

PUBLIC SERVICE CORPORATION OF NEW JERSEY.—The directors of the Public Service Corporation of New Jersey have increased the quarterly dividend rate of the company from 1 to 1¼ per cent, thus putting the stock on a 5 per cent basis. The company has also formally authorized the issue of $4,750,000 additional capital stock and $8,000,000 of new bonds. This new stock will be offered to the present stockholders at par. The present market price of the stock is 107. The bonds were issued under the general mortgage of $50,000,000, will run 50 years and bear 5 per cent. They have already been sold to J. P. Morgan & Company and Drexel & Company. It is proposed to use the proceeds of the bond issue to retire the collateral gold notes due Nov. 1 and the proceeds of the stock sale to make extensive improvements.

SLUMP IN CHICAGO SUBWAY STOCK.—The heavy selling of the stock of the Chicago Subway Company has continued during the past week, and the price has declined still further. While it is rather definitely known that insiders have been liquidating extensively, the reason for their selling has not been made public. One large holder is reported to have disposed of 10,000 shares of stock and to have invested the proceeds of the sale in the bonds of the company. A. G. Wheeler, president of the company, declares that there is no cause for the decline, and says that the earnings are increasing and that the company has just ordered 2000 additional cars and 100 additional locomotives to care for its extra business.

INTERNATIONAL TRACTION COMPANY.—It is reported in Buffalo that there will soon be a readjustment of the financial affairs of the International Traction Company. This does not mean that there will be an immediate payment of the back dividends. The International Traction Company owns the entire capital stock of the International Railway Company, which operates the street railways in Buffalo and vicinity. The traction company has now due and unpaid accumulated dividends amounting to about 40 per cent.

ELMIRA WATER, LIGHT & RAILROAD COMPANY.—The Public Service Commission of the Second District has authorized the Elmira Water, Light & Railroad Company to issue bonds to the amount of $196,000. The proceeds of about $60,000 of these bonds will be used to pay the outstanding indebtedness, and the balance will be used for future improvements and extensions. It is expected to install a new steam turbine plant at the Madison Avenue power house and to make an extension of the street railway on Maple Avenue.

EXTRA DIVIDEND ON WESTINGHOUSE AIR BRAKE STOCK.—The directors of the Westinghouse Air Brake Company, in addition to declaring the regular quarterly dividend of 2½ per cent, have declared an extra dividend of 1½ per cent on the capital stock of $14,000,000. The present business of the company warrants this payment. It is said that the Wilmerding plant is crowded with orders and that the full complement of employees, 3800 men, is now at work.

QUEBEC RAILWAY, LIGHT & POWER COMPANY.—The report for the year ended June 30, 1909, of the Quebec Railway, Light & Power Company shows gross earnings of $724,648, and net earnings of $280,348; the latter compares with net earnings of $236,461 of the previous year. The customary dividends on the stock were paid, and at the annual meeting the old board of directors was elected.

GENERAL ELECTRIC COMPANY'S DIVIDENDS.—While it is generally admitted that the business of the General Electric Company is gradually increasing, and that the big concern is now operating with about 85 per cent of capacity, it is positively denied that the board of directors has in any way considered an increase in the regular dividend. It is stated that the directors believe that the 8 per cent rate is a fair return, and that any surplus above this amount should be reinvested rather than given to the stockholders at present. It is intimated that with the next few years continuously prosperous a stock dividend might be advisable in two or three years.

WILMINGTON GAS COMPANY'S BONDS.—Drexel & Company, of Philadelphia, and Brown Bros. & Company, of New York, are offering $2,000,000 of 5 per cent bonds of the Wilmington Gas Company to the public. These bonds mature in 1949, and are a portion of a $5,000,000 issue. They are being offered at 98 and interest. The franchises of the Wilmington Gas Company are perpetual, and the company has the right to manufacture and distribute electricity as well as gas. Since the property was taken over by C. H. Geist, last August, its physical condition has been greatly improved, and the plant is now thoroughly equipped with modern appliances.

BRUNSWICK (GA.) TERMINAL & RAILWAY SECURITIES COMPANY.—Circulars have been issued by Dick Brothers & Company, New York, announcing that the Brunswick (Ga.) Terminal & Railway Securities Company has taken over all the property of the Brunswick Dock & Improvement Company, the Brunswick & Suburban Railroad Company and the Mutual Light & Water Company. The two latter companies have been earning good dividends while the first named company has large holdings of valuable city lots and suburban real estate. The new holding company has capital stock of $7,000,000 with no bonds.

SCRANTON ELECTRIC COMPANY.—The stockholders of the Scranton (Pa.) Electric Company, a subsidiary of the American Gas & Electric Company, have voted to increase the capital stock from $3,000,000 to $7,000,000. The new stock will be divided into $5,000,000 common and $2,000,000 6 per cent cumulative preferred. This increase, it is said, is made for the purpose of paying for several plants which have been acquired recently and to make adequate provision for future development on them.

OHIO LIGHTING COMBINATION REPORT.—A report has recently been in circulation in the Wall Street district to the effect that the Standard Oil Company is behind a project involving the Columbia Gas & Electric Company, which has for its purpose the organization of a $20,000,000 concern to manage a number of other important gas and electric lighting concerns in that State. No information would be given out by the financial concerns supposed to be interested.

DIVIDENDS.

American Cities Railway & Light Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

Bell Telephone Company of Canada, quarterly, 2 per cent, payable Oct. 15.

Chicago City Railway Company, quarterly 1½ per cent, payable Sept. 30.

Duluth Edison Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

Electric Boat Company, preferred, quarterly, 2 per cent, payable Oct. 1.

General Motors Company, preferred, semi-annual, 3½ per cent, payable Oct. 1.

Massachusetts Lighting Companies, quarterly, 1½ per cent, payable Oct. 15.

Otis Elevator Company, preferred, quarterly 1½ per cent, payable Oct. 15.

Public Service Corporation of New Jersey, quarterly, 1¼ per cent, payable Sept. 30.

Scranton (Pa.) Electric Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

Shawinigan Water & Power Company, Montreal, quarterly, 1 per cent, payable Oct. 20.

Tri-City Railway & Light Company, Davenport, Ia., preferred, quarterly, 1½ per cent, payable Oct. 1.

Washington Water Power Company, Spokane, quarterly, 1¾ per cent, payable Oct. 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Light & Traction:					
August, 1909	$236,410	$8,214	$228,195	.....	.....
August, 1908	194,872	4,000	190,872	.....	.....
American Telephone & Telegraph Company:					
August, 1909	2,405,653	194,096	2,211,557	$511,464	$1,700,072
August, 1908	2,059,133	151,335	1,907,798	614,253	1,293,544
Binghamton Railway Company:					
Year ended Aug. 31, 1909	337,090	189,674	147,416	108,533	38,883
Year ended Aug. 31, 1908	311,626	187,413	124,213	101,308	22,905
Boston Suburban Electric Companies:					
August, 1909	89,907	56,535	33,434	13,409	20,025
August, 1908	90,522	54,926	35,595	13,015	22,580
Economic Light & Power Company, Joliet, Ill.:					
Year ended April 30, 1909	310,402	138,739	171,663	65,324	106,339
Year ended April 30, 1908	276,881	119,892	156,989	64,145	92,844
Edison Electric Illuminating Company of Boston:					
Year ended June 30, 1909	4,111,342	2,766,029	1,345,313	.....	.....
Year ended June 30, 1908	4,229,239	2,690,419	1,538,820	.....	.....
Ft. Wayne & Wabash Valley Traction Company:					
June, 1909	115,980	70,687	45,293	.....	.....
June, 1908	110,034	65,442	44,592	.....	.....
Pacific Telephone & Telegraph Company:					
July, 1909	1,035,518	701,122	334,396	103,793	230,603
July, 1908	1,012,967	698,746	314,223	99,771	206,508
Paducah Traction & Light Company:					
June, 1909	18,101	10,613	7,487	6,631	856
June, 1908	18,496	12,222	6,273	6,847	574
Pensacola (Fla.) Electric Company:					
June, 1909	20,126	11,291	8,834	4,263	4,571
June, 1908	19,020	14,020	5,000	4,314	685
Philadelphia Rapid Transit Company:					
Year ended June 30, 1909	18,317,539	9,364,737	8,952,792	.....	.....
Year ended June 30, 1908	18,300,080	9,794,508	8,505,572	.....	.....
Rutland Railway Light & Power Company:					
Year ended Aug. 31, 1909	252,876	132,099	120,777	81,396	39,381
Year ended Aug. 31, 1908	254,527	138,137	11,639	.....	.....
St. Joseph (Mo.) Railway, Light, Heat & Power Company:					
July, 1909	85,392	43,766	41,626	21,636	19,990
July, 1908	80,439	38,785	41,952	20,666	21,286
Savannah Electric Company:					
June, 1909	52,134	33,385	18,748	17,343	1,405
June, 1908	50,005	30,498	19,507	17,322	2,185
Seattle Electric Company:					
June, 1909	522,469	313,013	209,455	105,092	104,363
June, 1908	358,207	202,874	155,332	93,695	61,637
Tampa Electric Company:					
June, 1909	46,638	28,473	18,165	4,719	13,456
June, 1908	45,070	31,838	13,231	2,571	10,660
United Railways of St. Louis:					
August, 1909	957,246	599,645	357,601	232,420	125,181
August, 1908	911,515	572,879	338,636	234,551	104,085
Westinghouse Air Brake Company:					
Year ended July 31, 1909	5,286,021	3,246,748	2,039,273	118,716	1,920,557
Year ended July 31, 1908	5,308,016	3,293,260	2,014,756	43,960	1,970,796

*Deficit.

GENERAL NEWS

Construction News.

DADEVILLE, ALA.—The Dadeville telephone system has been sold to the Southern Bell Telephone Company, the property to change hands not later than Jan. 1, 1910. The City Council had revoked the franchise of T. B. Griffin, the present owner, on account of poor service, but owing to the sale he will be allowed to continue operating the system until the new owners take possession.

MONTGOMERY, ALA.—The City Council has granted the Montgomery Traction Company a franchise to extend its electric railway along Jeff Davis Avenue from Holt Street to Oak Street, for which the company paid the city $2,000.

HELENA, ARK.—The Helena Street & Interurban Railroad Company has awarded the contract for the construction of the proposed electric railway between Helena and West Helena, a distance of four miles, to R. L. Leonard, of Helena. The cost of the railway, not including power plant, is estimated at $40,000. The power plant will be located in West Helena.

NASHVILLE, ARK.—Leo Loeb and George Schmial, of Hot Springs, Ark., are interested in a project to erect an electric light plant in Nashville.

COALINGA, CAL.—The San Joaquin Light & Power Company, of Fresno, Cal., it is reported, is planning to install an electric light and water system in Coalinga, the cost of which is estimated at $1,000,000.

COLMA, CAL.—At an election held recently the residents of Colma, Hillcrest, Crocker tract and Vista Grande, voted to form a lighting district to be known as the Colma lighting district.

FRESNO, CAL.—It is understood that contracts will be let soon for the machinery and equipment for the addition to the hydro-electric plant of the San Joaquin Light & Power Company, increasing the output by 10,000 hp. The work will include the enlargement of the Crane Valley dam and reservoir and extension of flume lines. Plans and specifications, it is said, for the machinery and pipe lines can be secured upon application to J. G. White & Company, 43 Exchange Place, New York, N. Y., who have charge of the work.

KENNETT, CAL.—W. R. Conant and W. D. Pratt have appropriated 1000 cu. in. of water of Castle Creek, to be diverted near the head of the creek, which is the outlet of Glacier Lake, five miles west of Castella. It is proposed to utilize the water for the development of electricity, which will be transmitted to Delta, Lamoine and Castella. The plant will have an output of about 2000 hp.

LOS ANGELES, CAL.—The Board of Public Works has made application for an issue of $3,500,000 in bonds, the proceeds to be used in connection with the power development project of the Los Angeles aqueduct.

OAKLAND, CAL.—The Central Oakland Light & Power Company has filed a mortgage in favor of the First Federal Trust Company to secure an issue of $800,000. The mortgage is signed by A. M. Hunt, president of the company, and Clyde M. Beal, secretary.

ORLAND, CAL.—At a special election held recently the citizens of Orland voted to form a lighting district in accordance with the new law passed by the last Legislature.

OROVILLE, CAL.—Notice of appropriations have been filed by R. Leo Van Wormer in Butte County. One for 50,000 in. of water from the Middle Fork of the Feather River, and the other for 1000 in. from Mosquito Creek, a tributary of the Middle Fork. It is proposed to use the water for power development.

REDDING, CAL.—Notice of appropriation of 250,000 cu. in. of water in the Pitt River, near the mouth of the Burney River, has been filed by J. H. Logan, of Santa Cruz. The water is to be conveyed through a canal a distance of 30 miles, six or seven miles of which will be through a tunnel penetrating a mountain range, where power plants will be erected capable of generating 400,000 hp. The water will be available below the power plants for irrigating the land in the upper part of Sacramento Valley.

SAN BERNARDINO, CAL.—A movement is on foot to install an ornamental illuminating system for lighting the business section of the city similar to the system now in use in Los Angeles. H. J. Hanford is interested in the project.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has been granted a franchise by the City Council to extend its system over certain streets in San Diego.

SAN JOSE, CAL.—The Pacific Telephone & Telegraph Company contemplates extensive improvements to its local system, which will involve an expenditure of about $300,000 and will include the erection of a new exchange building, installation of new switchboard and telephone equipment and additional underground conduits, cables and outside wires.

SANTA ROSA, CAL.—Application has been made to the County Board of Supervisors by the Russian River Light & Power Company to furnish electricity for lamps and motors in the towns of Guerneville, Forestville, Occidental, Freestone, Monte Rio, Duncans Mills, Camp Meeker, Monte Cristo, Mesa Grande, Cazadero, Molino, Graton and other summer resorts in Western Sonoma.

SEBASTOPOL, CAL.—The Board of Supervisors has granted H. C. Eastman a franchise to erect a transmission line from Sebastopol to the towns of Graton, Forestville, Guerneville, Monte Rio, Camp Meeker, Occidental, Freestone, Duncans Mills, Markhams and Cazdero, to supply electricity for lamps and motors in the above towns. Electricity for the system will be supplied from the plant of the Pacific Gas & Electric Company in Sebastopol. Contracts have already been secured by Mr. Eastman for lighting the towns mentioned.

SALIDA, COL.—Preparations are being made by the Colorado Telephone Company for extensive improvements to its system in Salida, which will involve an expenditure of about $35,000. The present overhead wires will be replaced with cables.

SUGAR CITY, COL.—The Sugar City Electric Light & Power Company, recently organized, has applied for a franchise to construct and operate an electric light and power plant in Sugar City. R. F. Bornschien, W. F. Bornschien and H. P. Bornschien are incorporators.

JEWETT CITY, CONN.—Negotiations have been completed between the Borough Electric Light Commissioners and the Nashewaug Electric Power Company whereby the latter will supply electricity for lamps and motors in Jewett City. It is understood that the service will begin in about six months and a 24-hour service established. The plant of the new company has not yet been built. It is thought that it will be located in Chaplin. The present plant will be held for use in emergencies. The charter of the company gives it the right to supply electricity in the towns of Canterbury, Chaplin, Plainfield and Griswold. S. M. Taber, of New Bedford, Mass., is president of the new company, and Frank Perry, of Boston, Mass., secretary.

SUFFIELD, CONN.—The Connecticut Company has sold five steam boilers, two pumps and two steam engines at the Mapleton power house in order to make room for improvements to be made soon. The company proposes to rebuild a portion of the building and install new machinery. Electricity for operating the system is supplied from the Springfield plant and the local plant will be converted into practically a substation.

SOUTH MANCHESTER, CONN.—The incandescent lighting system of the South Manchester Light & Power Company has been extended to include Edgewood tract.

WILMINGTON, DEL.—The West Chester & Wilmington Electric Railway Company will soon commence work on the construction of its proposed electric railway between West Chester, Pa., and Wilmington, for which surveys have been made and the right of way secured. The railway will be 17 miles in length.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Oct. 5, to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal. Schedule 1625—One 40 and one 10-ton overhead traveling crane, one 40 and one 10-ton crane runway extension to 40-ton crane runway. Newport, R. I. Schedule 1685—Twelve geared head motor-driven engine lathe with spare parts. Pensacola, Fla. Schedule 1681—Machinery for central power plant. Washington, D. C. Schedule 1686—Furnishing and installing a complete outfit of tank pumps and piping for an oil storage and distributing system. Schedule 1683—Two motor-driven centrifugal pumps. Schedule 1684—Complete equipment for oxygen and acetylene generating and compressing machines. Brooklyn, N. Y. Schedule 1671—1500 lb. magnet wire. Schedule 1678—130 generator and circulating tubes. Applications for proposals should designate the schedules desired by number.

WASHINGTON, D. C.—The contract for furnishing motor generator sets for the Philadelphia navy yards, bids for which were opened July 10, was awarded to the Allis-Chalmers Company, of Milwaukee, Wis., for $18,125.

WASHINGTON, D. C.—The Washington, Baltimore & Annapolis Railway Company has awarded the contract for the construction of a substation in Ardmore, Md., to Edward Waters & Company, to cost $8,000.

WASHINGTON, D. C.—The contracts for furnishing one 1000-kw and two 1500-kw turbo-generators for the New York, Philadelphia and Boston navy yards have been awarded to the Westinghouse Machine Company, for $64,750.

FORT PIERCE, FLA.—The proposition to issue $10,000 in bonds for the installation of a municipal electric light plant will be submitted to the people at an election to be held soon. The proposition to grant a franchise to the St. Lucie Ice Company to establish an electric light plant was defeated.

PENSACOLA, FLA.—The Suburban Railway Company has made application for a charter for the purpose of taking over the electric railway of the East Pensacola City Company, extending from Sixteenth Street across Bayou Texar to Magnolia Bluff Park at East Pensacola, a distance of about two miles. The company is capitalized at $50,000, and the

incorporators are: John E. Stillman, Knowles Hyer, Henry M. Yonge and W. A. Blount, Jr.

PENSACOLA, FLA.—Application has been made to the City Council by the East Pensacola City Company for a franchise to extend its electric railway to the business district of Pensacola.

ATHENS, GA.—The Atlanta Power Company has purchased the water-power rights at Tallulah Falls of Moss Brothers, of Athens, Ga., for $100,000. It is said that the Atlanta Power Company will develop 18,000-hp, the greater part of which will be used in Atlanta.

CUTHBERT, GA.—At an election to be held Oct. 12 the proposition to issue bonds for improvements to the municipal electric light plant and water works systems will be submitted to the people.

PECK, IDAHO.—D. E. Peck is reported to be contemplating the installation of an electric light plant in connection with his mill.

SAINT MARIES, IDAHO.—Unless the village officials can make satisfactory arrangements with individual corporations for lighting the town, a municipal electric light plant may be installed in the near future.

CARTERVILLE, ILL.—The Interurban Electric Company, recently incorporated, contemplates acquiring a plant and increasing the output by the installation of a 300-kw turbine and also proposes to erect transmission lines from Herrin, Ill., to Cartersville and Reeves. A day service will also be established, it is said. The company is capitalized at $150,000 and F. W. Richart, E. E. Denison and H. B. Cassel are the incorporators.

CHAMPAIGN, ILL.—The Illinois Traction System, it is said, is planning to erect a power station at Venice, Ill., which will have an output of 10,000 hp. The cost of the plant is estimated at $500,000 and it will furnish electricity to operate the southern division of the system.

CHICAGO, ILL.—Plans have been prepared for installing two pumping engines in the Roseland pumping station with a capacity of 50,000,000 gal. per day, to be operated by electricity. The energy will be furnished by the Sanitary District of Chicago, the Commonwealth Edison Company furnishing emergency service. It is expected to have the station in service within a year.

ELBURN, ILL.—Work has commenced on the construction of the new electric plant for Elburn, the contract for which was awarded to the International Harvester Company, for about $5,500. The contract includes the construction of the plant complete and calls for the erection of 43 street lamps of 80 cp, and for equipment of sufficient output to supply the street lighting system and 600 incandescent lamps for commercial purposes. It is expected to have the plant in operation by Nov. 15.

MOLINE, ILL.—Franchises have been granted by the Bettendorf Village Board to the Bettendorf Improvement Company to operate an electric light plant and water works system for a period of 25 years. Work is to be started on the electric light plant within three months and is to be completed in six months, and the water works within one year. The streets of the village are to be lighted with 20 arc lamps. W. P. and J. W. Bettendorf are principal stockholders of the company.

OTTAWA.—ILL.—W. D. Boyce, of Marseilles, Ill., has applied to the City Council for a 50-year franchise to construct transmission lines in the streets of the city for the distribution of electricity. The company now has its transmission line erected from its hydroelectric plant in Marseilles to Ottawa.

PARIS, ILL.—The City Council has granted the Paris & Northern Traction Company a 50-year franchise to build its proposed electric railway on West Washington Street east to connect with the Terre Haute & Western Railway at Paris. The railway will connect Ridgefarm and Paris, a distance of 26 miles. W. M. Bridgett is president.

TREMONT, ILL.—The capital stock of the Farmers Mutual Telephone Company has been increased from $20,000 to $40,000.

WATERTOWN, ILL.—Application has been made to the Board of Trustees by the Tri-City & Northeastern Interurban Railway Company, of Port Byron, Ill., for a franchise to operate its proposed electric railway in Watertown. The railway will extend from Albany to Watertown.

BLUFFTON, IND.—The City Council is asking for bids for the construction of twenty arches for lighting the city streets.

COLUMBIA CITY, IND.—The contract for installing boilers in the municipal electric light plant was awarded to the Wickes Boiler Company, of Saginaw, Mich.

ELKHART, IND.—Plans have been completed for the installation of the "gooseneck" lighting system in this city, similar to that now in use in Mishawaka. Nearly all the business houses have agreed to pay their share of installing the system in the business section.

KINGMAN, IND.—The Covington & Southeastern Railway Company has filed a trust deed in favor of the Union Trust Company, of Indianapolis, Ind., for $825,000, to secure an issue of bonds, the proceeds to be used for the construction of an electric railway to penetrate Parker County coal fields, and which will probably be extended to Crawfordsville from Covington.

NEW CASTLE, IND.—It is reported that arrangements have been made for the installation of electrical equipment and machinery in the power house of the Indianapolis, New Castle & Toledo Railway Company in New Castle at once. This equipment was partially installed previous to the appointment of the Union Trust Company, as receiver, and was subsequently removed.

NEW CASTLE, IND.—The Union Trust Company, of Indianapolis, Ind., receiver of the Indianapolis, New Castle & Toledo Electric Railway Company, of New Castle, Ind., has been authorized by the superior court to issue $460,000 in receiver's certificates. The first contract for the construction of the proposed railway has been awarded by the receiver to W. C. Miller, of Indianapolis, Ind.

SOUTH BEND, IND.—Franchises have been granted by the Commissioners of St. Joseph County to the Citizens' Mutual Telephone Company to construct and operate telephone lines in four townships of St. Joseph County. Work will soon be started on the lines in the towns of Union, Greene, Liberty and Lincoln.

HARLAN, IA.—A franchise has been granted to the Farmers' Mutual Telephone Company, of Portsmouth, to construct and operate a telephone line in Harlan.

IOWA CITY, IA.—The Interstate Power Company has applied to the City Council for a 25-year franchise to establish an electric light plant and street railway in Iowa City. It is said that the company proposes to erect a large power plant in this city and has secured options on the mill property and water rights owned by Harp & Roberts. It is proposed to erect a dam 30 ft. high across the Iowa River below the Oak Street bridge. It is estimated that from 2500 to 3000 hp can be developed. The company offers to furnish electricity for lamps at a maximum rate of 10 cents per kw-hour and for power at 8 cents per kw-hour, and to furnish 40 arc lamps of 2000 cp for street lighting at the rate of $2 each per month, and also to furnish electricity to light all the city buildings free of charge. It is reported that the company has secured options on plants in Hampton, Eldora and other towns. M. G. Albrook, of Delhi, Ia., is representing the company in this city.

MARSHALLTOWN, IA.—The Iowa Light & Traction Company, through its local representative, J. H. McBride, has submitted a proposition to the City Council to construct an interurban railway from Marshalltown to Grundy Center and from Marshalltown to Ames, Ia., within three years, providing the company is granted a franchise by the city. The company also proposes to purchase the property of the Marshalltown Light, Power & Railway Company, and to extend the local railway to the city park and fair grounds. Andrew Stevenson, 153 La Salle Street, Chicago, Ill., is president and general manager. Headquarters of the company are located at Chicago, Ill., and Eldora, Ia.

RED OAK, IA.—Preparations are being made by the Red Oak & Northeastern Railway Company to commence work on the construction of its proposed electric railway from Red Oak through Greenfield to Des Moines, a distance of 110 miles.

STRAWBERRY POINT, IA.—B. W. Newberry and J. C. Flenniken, of Strawberry Point, are interested in a project to construct an electric railway next season from Oelwein to Strawberry Point, a distance of 20 miles.

WATERLOO, IA.—Extensive improvements are contemplated by the Iowa Telephone Company to its local system, which will involve an expenditure of about $100,000 and include the installation of a new switchboard and the erection of additional cables.

ERIE, KAN.—Plans are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., consulting engineers, for the construction of an electric light plant and water works system to cost about $50,000.

WAKEENEY, KAN.—Contracts for the equipment of the municipal electric light plant, bids for which were opened Sept. 15, were awarded as follows: For machinery to the Fairbanks, Morse Company, of Kansas City, Mo., for $4,550, and for transmission lines to Charles Steinberger, of Wakeeney, Kan., for $4,150. George P. Taylor, of Stockton, Kan., is engineer.

ALEXANDRIA, LA.—We are informed that bids will be opened about Oct. 27 for extensions to electric light plant and water works system, for which bonds to the amount of $40,000 were recently voted. I. W. Sylvester is city engineer.

LAKE CHARLES, LA.—Arrangements are being made by the Longville Long Leaf Lumber Company for the construction of a telephone line from this city to Longville.

LAKE CHARLES, LA.—Plans are being considered by the City Council for making extensions to the electric light and water service.

MANDEVILLE, LA.—The Town Council has granted A. D. Piaggio, of New Orleans, La., a franchise to install an electric light and ice plant in Mandeville. Under the terms of the franchise, the company is to furnish six street lamps and electricity for lighting the town hall free of charge. It is expected to have the plant in operation by June, 1910.

NEW IBERIA, LA.—H. A. Mentz, Hennen Building, New Orleans, La., has withdrawn his application from the City Council for the purchase of the electric light and waterworks plant, as a stipulation to build a street railway in New Iberia, and an interurban railway to Jeanerette. The franchise for the construction of an interurban railway was accepted by Mr. Mentz.

BELFAST, MAINE.—The Penobscot Bay Electric Company, of Bucksport, Maine, has taken over the property of the Belfast Gas & Electric Company. It is said that the new company will install a 24-hour service.

SANFORD, MAINE.—Negotiations have been closed whereby the Portland Electric Light & Power Company is to furnish the Sanford Mills with electrical energy to the amount of 2000 hp from its power plant at West Buxton. At present the plant has an output of 3000 hp, all of which is distributed in Portland, Maine, and the additional contract means the development of the great water privilege at Bonny Eagle. It is also said that the company will install an auxiliary steam plant at West Buxton, for use, during the low-water periods. At present the Sanford Mills have a contract with the Atlantic Shore Line Railroad Company calling for 1600 hp, which is conditional, and only part of the contract is furnished during the summer when the water is low.

THURMONT, MD.—John R. Rouzer, P. N. Hammaker, J. W. Creager, M. A. Birely and others are interested in a project to organize a company to establish an electric light plant to be operated by water power. It is said that the city will eventually purchase the plant.

THURMONT, MD.—The citizens have decided to establish an electric light and power plant to furnish electricity for street lighting and for commercial use, work on construction of which will begin immediately.

CHICOPEE, MASS.—The report of the committee on electric lights, submitted to the Board of Aldermen recently, favors the installation of an electric lighting system in Fairview as well as Willimansett. The plan proposed by the committee is to take over the system in Fairview, now operated by the South Hadley Company, for which the city at present is paying $750 per year, and to extend the proposed transmission line from Willimansett to Fairview, by which electricity could be furnished to operate the pumping station of the Fairview water system. The cost of the proposed extension is estimated at from $15,000 to $18,000, and would require the installation of a new generator in the electric plant at the Center and also a motor at Fairview. It is estimated that about 200 hp would be available for manufacturing purposes.

FALL RIVER, MASS.—The Fall River Electric Light Company has applied to the Land and Harbor Commission for a license to lay and maintain a submarine cable for the transmission of electricity in Taunton River from Fall River to and near the Fall River-Somerset Bridge.

FITCHBURG, MASS.—Contracts have been signed whereby all electrical energy furnished to consumers by the Connecticut River Transmission Company in Fitchburg will be distributed over the transmission lines of the Fitchburg Gas & Electric Light Company. Negotiations are also under way for the purchase of electricity by the Fitchburg Gas & Electric Light Company from the Connecticut company for its own service. The Connecticut company now has contracts to furnish 1800 hp to the Parkhill Manufacturing Company to operate its three mills; the contract with the DeJonge Mills calls for 1200 hp and 800 hp for the Crocker, Burbank & Company. Under the terms of the contract all consumers using more than 300 hp will deal directly with the Connecticut River Transmission Company, which will pay rental to the local company. The smaller consumers will deal with the local company, who, under the contract not yet signed, will purchase energy from the Connecticut company.

HOPKINTON, MASS.—It is reported that the Middlesex & Boston Street Railway Company is contemplating the construction of a power house on East Main Street in Hopkinton.

OAK BLUFFS, MASS.—The Vineyard Lighting Company, which furnishes electricity for lamps and motors in Oak Bluffs and Vineyard Haven, is planning to extend its service to Edgartown, Mass. Arrangements are being made to increase the output of its plant, and orders have been placed for an additional generator direct connected to a compound condensing engine. It is expected to furnish electrical service in Edgartown by the first of November.

SOMERSET, MASS.—The Fall River Electric Company is making arrangements to extend its transmission lines into Somerset to furnish electricity for street lighting. The company agrees to furnish incandescent lamps of 40 cp at the rate of $20 each per year, or a 60-cp incandescent lamp for $25 per lamp per year, and asks for a guarantee of 100 lamps. At present there are about 90 gasoline lamps in the town.

SOUTH ROYALSTON, MASS.—J. V. Twitchell has been awarded the contract for the construction of three greenhouses and power plant for E. B. Hanson, of South Royalston, Mass.

WARE, MASS.—The Board of Overseers of the Poor is contemplating lighting the almshouse with electricity. At present the building is lighted by an acetylene gas plant. It is stated that it may be necessary to install an electric plant, as the Ware Electric Light Company is unwilling to stand the entire expense of extending its transmission line to the almshouse. It is estimated that the cost would be between $500 and $600.

WEST STOCKBRIDGE, MASS.—At a special town meeting held recently the citizens voted to install about 30 electric street lamps.

WORCESTER, MASS.—Arrangements are being made to change the plants of Loring Coes & Company, located on Coes Square, and Coes and Mill Streets, from steam to electric drive. Electricity for operating the plants will be furnished by the Worcester Electric Light Company. Frank L. Coes is president and treasurer of the company.

BAD AXE, MICH.—All the telephone lines in Huron and Sanilac counties have been merged under the name of the Consolidated Telephone Company. The company is capitalized at $250,000 and the main office will be located at Bad Axe.

BAUDETTE, MICH.—The contract for the installation of the electric light plant and pumping station is reported to have been awarded to J. G. Robertson, of St. Paul, Minn., for $15,240.

FLINT, MICH.—The Michigan Telephone Company has been granted permission by the City Council to extend its pole and conduit system in various streets in the city. The company is planning to erect a new exchange building and making extensions and improvements to its local system which will involve an expenditure of about $100,000.

THREE RIVERS, MICH.—The Sheffield Car Company, it is reported, will install a 500-kw, alternating-current generator in its plant in the near future.

WELLS, MICH.—It is reported that the Escanaba Extract Company, of Wells, Mich., is contemplating the installation of a power plant, bids for which will be asked in the near future. The equipment, it is said, will include six boilers of 125 hp each, a Corliss engine and an electric generator rated at 200 kw, feed pumps, heater, alternating-current motors and other machinery.

ADA, MINN.—Plans are being considered by the City Council and the Water and Light Board for installing a heating plant to furnish heat for buildings located in the business district. If it is decided to install the plant an addition will be required to the municipal power house and an additional boiler will be installed; a day electrical service may also be established.

DETROIT, MINN.—All bids opened Sept. 14 for the construction of a light, power and water plant in Detroit were rejected. W. L. Taylor is president of the lighting committee.

LE SUEUR, MINN.—Bids will be received by James A. Morgan, city clerk, until Oct. 1, for a Corliss heavy duty engine, to drive an alternating-current generator.

COLUMBIA, NEB.—The capital stock of the Platte Independent Telephone Company has been increased from $40,000 to $100,000.

OMAHA, NEB.—Plans are being prepared by the Cudahy Packing Company for the erection of a new plant for the manufacture of one of its products. A power plant will be erected, the equipment to include boilers, engines, electrical machinery, etc., for which it is understood that orders have not yet been placed.

CARSON CITY, NEV.—Bids will be received by the State Board of Commissioners for Care of the Indigent Insane, Carson City, Nev., until Oct. 11, for furnishing and installing at the Nevada Hospital for Mental Diseases material and equipment as follows: Pole lines, waterwheels, generators, exciters, switchboard, pumps, motors, wells, pipe lines, etc.

GORHAM, N. H.—The Cascade Light & Power Company, whose plant was recently damaged by fire, has resumed its service in Gorham. The customers of the Cascade company were supplied with electricity by the Berlin Mills Company, while its plant was out of commission.

PLAISTOW, N. H.—Plans are being made to install an electric light plant between Plaistow and Newton to furnish electricity for lighting the streets and residences in both villages.

BOONTON, N. J.—The Morris County Traction Company, of Morristown, N. J., has been granted a franchise by the Common Council to extend its railways through Boonton.

ALBION, N. Y.—The property of the Albion Power Company, of Albion, which included the Albion power plant, the plants at Rockport, Clark's Mills and Waterport, was sold under foreclosure proceedings by the People's Bank & Trust Company, of Passaic, N. J. The property was purchased by Lucien H. Tyng, of Philadelphia, Pa., a member of the committee of the bondholders of the Albion Power Company, for $38,250, the purchaser assuming the outstanding indebtedness of $120,000. The plant and holdings of the Middleport Gas & Electric Company were purchased by George F. Thompson, of Middleport, for the Middleport company, which is to assume the previous encumbrances. It is understood that the property is to pass into the hands of the A. L. Swett Electric Light & Power Company, of Medina, N. Y. As soon as the court confirms the sale the Swett company will connect its transmission lines with the lines of the Albion and Brockport plants. For the present Clayton C. Blood will be retained as business manager and Paul West as electrical engineer.

BATAVIA, N. Y.—The property of the Genesee County Light, Power & Gas Company was sold Sept. 8 to Rudolph C. Rabe, of New York, N. Y., representative of the bondholders and reorganization committee, for $100,500. The company distributes Niagara power in Batavia and elsewhere. It is proposed to continue the operation of the plant.

BUFFALO, N. Y.—The Public Service Commission, Second District, has authorized the Cataract Power & Conduit Company to issue $149,000 in bonds, to be sold at not less than 95, the proceeds to be used for the acquisition of property and for extensions and improvements to its plant.

ELMIRA, N. Y.—The Public Service Commission, Second District, has authorized the Elmira Water, Light & Railroad Company to issue bonds to the amount of $196,000. The proceeds of $59,874 will be used to pay outstanding indebtedness and the balance for future improvements, which will include the installation of a steam turbine at the Madison Avenue power plant, extension of the street railway on Maple Avenue to connect with the Waverly line and for water meters.

GLOVERSVILLE, N. Y.—Mortimer Everest, of Albany, N. Y., is reported to be seeking a franchise to furnish electricity in Gloversville and Johnstown. Mr. Everest is at the head of a company which proposes to furnish electricity for manufacturing purposes in both towns.

NIAGARA FALLS, N. Y.—John A. Roebling's Sons, of New York, N. Y., have been awarded the contract for furnishing and installing 18,000

ft. of transmission cable in conduits furnished by the city, for $10,285. Thomas H. Hogan is city clerk.

PORT BYRON, N. Y.—The Board of Village Trustees has engaged H. B. Sweet, of Utica, N. Y., engineer, to prepare plans for a municipal electric light plant to cost about $15,000.

WATERTOWN, N. Y.—Arrangements have been made by the Shaughnessy Knitting Mills, of Amsterdam, N. Y., to move its plant to Watertown. The company for the present will occupy one floor in the James D. Wise building in this city and will construct a new plant as soon as possible on land donated by the Watertown Light & Power Company.

FORT LINCOLN, N. D.—Bids will be received at the office of the constructing quartermaster, Fort Lincoln, N. D., until Oct. 19, 1909, for furnishing labor and material for wiring buildings at Fort Lincoln, according to plans and specifications; also for furnishing and erecting poles and wires around garrison and down to the end of the reservation road. Information will be furnished on application to above office. Lieut. J. D. Elliott, U. S. A., is constructing quartermaster.

LANGDON, N. D.—Arrangements are being made to erect a telephone line from Langdon to Waterloo by the farmers along the route, which will be connected with the Langdon exchange.

MANDAN, N. D.—The Mandan Electric Company, which was formerly owned and operated by the Missouri Valley Milling Company, has been reorganized with a capital stock of $20,000. The company is constructing a new plant, including the installation of new boilers, engines and generators, and is changing the system from single to three-phase and from 1100 to 2300 volts. Equipment for the plant has been purchased. B. K. Skeels is superintendent.

CLIFTON, OHIO.—The Village Council has granted the Cedarville Light & Power Company, of Cedarville, Ohio, a franchise to furnish electricity for lamps in this village. It is expected that the company will supply incandescent lamps for street lighting in the near future.

CUYAHOGA FALLS, OHIO.—Plans are being prepared by the Falls River & Machine Company for the construction of a power plant. E. Seedhouse is president.

DAYTON, OHIO.—In a report submitted to the City Council by City Engineer Cellarius the cost of installing the boulevard lighting system in the district outlined by the Council is estimated at about $32,742. The total amount is to be assessed against the abutting property owners.

MT. HEALTHY, OHIO.—The capital stock of the Mt. Healthy Light & Power Company has been increased from $10,000 to $45,000. Paul M. Hooven, of Hamilton, Ohio, is president.

NEW WASHINGTON, OHIO.—The local telephone company has been granted a new franchise by the Village Council, under which it may erect poles to carry its cables. It is said that there will be considerable extensions to the system.

ORRVILLE, OHIO.—Announcement has been made by Councilman Orrville that he will introduce an ordinance in the Council to provide for a bond issue of $100,000 for the erection of a municipal electric light plant, so that the question may be submitted to a vote of the people at the November election. The street lighting costs the city about $50,000 a year at present.

SANDUSKY, OHIO.—E. A. Bechstein, superintendent of the Sandusky Gas & Electric Company, writes that during October the company will install one 750-kw Westinghouse, three-phase, 60-cycle, 2300-volt turbo-generator; one Westinghouse 450-kw, belted, three-phase, 60-cycle, 2300-volt generator; one 150-kw motor-generator set consisting of synchronous motor driving a 500-volt direct-current generator. Line voltage will be changed from 1100 to 2300 volts; also from 133 to 60 cycles. All of the present electrical machinery will be discarded, except one 113-kw, 500-volt, direct-current generator, and all engines except one 600-hp Allis and a 125-hp Ball. No change will be made in boiler equipment.

DURANT, OKLA.—The city is reported to have sold $50,000 in bonds, the proceeds to be used to establish a municipal electric light plant and other public improvements. Plans are being made by the city for the construction of a municipal electric light plant. It is said the proposed plant will be erected in Armstrong, six miles northwest, on the Blue River. It is also proposed to supply Caddo with water and electricity.

EL RENO, OKLA.—It is reported that the plant and holdings of the El Reno Gas & Electric Company have been purchased by H. M. Byllesby & Co., of Chicago, Ill. The new owners, it is said, will extend the electric service throughout the city and suburbs. H. H. Stephens will be retained as local manager.

LAWTON, OKLA.—J. S. Danneck and D. L. Sleeper have applied to the City Council for a franchise to construct and operate an electric railway in Lawton.

MUSKOGEE, OKLA.—The Muskogee Electric Traction, it is reported, contemplates making extensions to its system in Muskogee. R. D. Long is general manager.

RYAN, OKLA.—We are informed that bids will be opened Oct. 4 for the construction of an electric light plant and water works and sewer systems. The cost of the electric light plant is estimated at $6,000 and the water works $45,000. J. W. Borum is city clerk.

PORTLAND, ORE.—It is reported that the Seventh Street Improvement Club will soon award contracts for furnishing lamp posts with a cluster of five lamps every alternate 50 feet on each side of Seventh Street, between Couch and Jefferson Streets. Charles A. Malarkey is interested in the project. It is expected that similar lamps will soon be placed on other streets.

VALE, ORE.—R. C. Carter, manager of the Idaho Electrical Company, of Boise, Idaho, is reported to have purchased the plant and holdings of the Vale Light & Water Company. The council has granted Mr. Carter a franchise to lay pipes to furnish water to the town.

WOODBURN, ORE.—The City Council has granted the Oregon Electric Railway Company a franchise to construct and operate an electric railway in Woodburn.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until Sept. 28 for furnishing articles as per circular (No. 537-A) as follows: Locomotive coaling cranes, iron and steel castings, motors, transformers, searchlights, arc lamps, die blanks, rubber belting, etc. Blanks and general information can be obtained from the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y., and 55 National Realty Building, New Orleans, La.; also from the U. S. engineer offices in the following cities: Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Chicago, Ill., and St. Louis, Mo. Captain F. C. Boggs is general purchasing officer.

BROWNSVILLE, PA.—John Wolfe, of Homestead, Pa., has secured the contract for the construction of a power house for W. Harry Brown, in Brownsville. The cost of the building is estimated at about $20,000.

GETTYSBURG, PA.—The property of the Gettysburg Transit Company was sold at a trustees' sale for $60,000 to C. F. Kraft, of Philadelphia, Pa., representing the Central Trust Company.

HARRISBURG, PA.—Bids will be received at the office of the city clerk until Sept. 27 for lighting the Herr and Market Street subways, containing respectively 16 and 10 incandescent carbon filament lamps of 16 cp from Oct. 10, 1909, to July 4, 1910, and from Oct. 10, 1909, to June 1, 1912, which shall include maintenance and replacement of all lamps; for lighting the Mulberry Street bridge with 10-watt tungsten lamps from Oct. 10, 1909, to July 4, 1910, and from Oct. 10, 1909, to June 1, 1912, to include maintenance and replacement of all lamps and the ground glass enclosing globes; for furnishing electricity for the lighting of the municipal filtration plant, the pumping station and fire engine houses, the bids to state the rate per kw-hour on a meter basis from Oct. 10, 1909, to July 4, 1910, and from Oct. 10, 1909, to June 1, 1912, which shall include the maintenance and replacement of all lamps.

SCRANTON, PA.—The Scranton Electric Company, of Scranton, Pa., a subsidiary of the American Gas & Electric Company, of Philadelphia, Pa., has increased its capital stock from $3,000,000 to $7,000,000, the proceeds of part to be used to finance the purchase of a number of plants which have been acquired during the past year and the remainder for future developments. Of the new stock $250,000 will be issued at once.

TOWANDA, PA.—A charter will soon be applied for, asking for permission to construct a dam in the Susquehanna River near Towanda. The proposed dam will cover nearly 1800 acres, land for which has nearly all been secured. It is expected to have the dam completed in three years and to furnish power in Towanda, Athens, Sayre and other towns. Meikleham & Dinsmore, of New York, N. Y., are interested in the project.

WEST NEWTON, PA.—The City Council has granted the Pittsburgh, McKeesport & Westmoreland Railway Company a franchise to construct an electric railway in West Newton.

ANDERSON, S. C.—We are informed that the Anderson Water, Light & Power Company has awarded the contract for improvements to its power plant at Portman Shoals to the General Electric Company, of Schenectady, N. Y. H. A. Orr is president and manager.

MARION, S. C.—The plant and holdings of the Marion Water, Light & Power Company have been purchased by Martin Maloney, of Philadelphia, Pa. It is understood that the company will be reorganized and improvements made to the system.

ROCK HILL, S. C.—Application will be made at the next meeting of the City Council for a franchise for a proposed electric railway to extend from Rock Hill north to the Catawba River. J. M. Cherry, of Charleston, S. C., is reported to be interested in the project.

ABERDEEN, S. D.—The stockholders of the Dakota Central Telephone Company have authorized an expenditure of $300,000 for improvements and extensions to its system during 1910.

LAKE PRESTON, S. D.—The new electric light system has been completed and put in operation. The plant is owned and operated by the Lake Preston Milling Company.

TYNDALL, S. D.—Plans are being considered for the construction of a municipal lighting system and pumping station, and also the installation of a gas producer engine.

WATERTOWN, S. D.—It is reported that Ferris Brothers, owners of the local electric lighting plant, contemplate reconstructing their plant, and will be in the market for electrical machinery this fall.

MEMPHIS, TENN.—The Southern Steel Company is reported to have awarded a contract to the Northern Electric Company for electrical equipment amounting to $75,000, and has also awarded a contract for electric cars valued at $65,000.

AMARILLO, TEX.—William O. Miller, Jr., of Amarillo, is reported to be interested in a project to construct an electric railway between Amarillo and Canyon City.

ELGIN, TEX.—The question of establishing an electric light plant in Elgin is under consideration. W. H. Kannedy is mayor.

FLOYDADA, TEX.—Plans are being made to establish an electric light and ice plant in Floydada. Robert Hailey, of Matador, Tex., is interested in the project.

HASKELL, TEX.—Application has been made to the City Council for a franchise by M. R. Hemphill to construct a street railway three and one-half miles in length.

TEMPLE, TEX.—The plant of the Temple Electric Light Company is being remodeled and enlarged in order to meet the increased demands made upon it. The cost of the improvements is estimated at about $30,000.

WALNUT SPRING, TEX.—The construction of an interurban railway from Walnut Springs to Glenn Rose is under consideration. Judge Sadler and J. H. Farr, of Glenn Rose, are interested in the enterprise.

BURLINGTON, VT.—The City Council has appropriated $6,000 for the installation of a new boiler in the municipal electric light plant.

FORT MYER, VA.—Bids will be received by Captain Warren W. Whiteside, constructing quartermaster, until Oct. 14 for interior electric wiring of 44 buildings, including fixtures and the installation of a complete outside distributing system for the post. Alternate bids are asked for underground and overhead distributing system. Plans and specifications will be furnished upon application. A deposit of $10 will be required to insure their safe return.

COLVILLE, WASH.—The Board of County Commissioners has granted the Ione Water & Light Company, of Ione, Wash., a 25-year franchise to install an electric plant in Colville.

COSMOPOLIS, WASH.—The Grays Harbor Railway & Light Company has been granted a franchise to furnish electricity in Cosmopolis for lamps and motors. In extending its lines to Cosmopolis it will be necessary for the company to lay a cable across the Chehalis River.

SEATTLE, WASH.—Frank McKeen, manager of the Ranier Power & Irrigation Company, of Seattle, is reported to have secured control of several power plants along the Columbia River, from which it is estimated that 45,000 hp can be developed. He has secured water rights on the lower 160 ft. at Chelan Falls on the Chelan River, for $150,000, where it is estimated that 15,000 hp can be developed. Three power plants on the Methow River have also been secured; one at Black Canyon, where 8000 hp can be developed, one near Winthrop, capable of developing 10,000 hp and one at Twisp, which is larger than the other two.

SEATTLE, WASH.—Contracts have been awarded for the installation of cluster lamps on First Avenue, between Virginia Street and Don Way, as follows: To the Olympia Foundry Company, for lamp posts, at $3,440, and for conduits to the Agutter & Griswold Company, for $24,658.

RICHWOOD, W. VA.—It is reported that the Cherry River Paper Company is planning to install two exhaust steam turbines and alternators with a rating of 750-hp each, with exciters, switchboards, etc.

LA CROSSE, WIS.—Negotiations are under way for the purchase of the La Crosse Telephone Company's system by the Wisconsin Telephone Company.

LA CROSSE, WIS.—The La Crosse Telephone Company is contemplating extensive improvements to its system and proposes to increase its capital stock to $100,000.

MADISON, WIS.—The Constantine Manufacturing Company is contemplating the erection of a new factory in Madison, the equipment of which will include a producer gas plant and engine, motors, etc. A blower for dust-collecting system will also be installed.

MILWAUKEE, WIS.—The Koehring Machine Company, it is said, will require new equipment for its new machine shop, including a 50-kw engine, engine-driven generating unit and a line of small motors for both individual and group drives, and other machinery.

CALGARY, ALTA., CAN.—The City Council will soon submit a by-law to the ratepayers to provide for a sale of bonds amounting to $40,000, the proceeds to be used for street railway purposes. The street railway bylaw originally was for $476,000, but this amount has been found to be insufficient.

LETHBRIDGE, ALTA., CAN.—Hon. W. H. Cushing, minister of public works for Alberta, states the government telephone system will be extended from here to connect with the several independent telephone companies operating across the border in British Columbia.

FORT WILLIAM, ONT., CAN.—The City Council has decided to extend the municipal telephone system throughout the Township of Paipoonge. Tenders for the work will be called as soon as the surveys have been made.

FORT WILLIAM, ONT., CAN.—It is the intention of the Canadian Pacific Railroad Company to have its lines between Fort William, Ont., and Brandon, Man., handled entirely by telephone within a year. At the present time the company is erecting about 531 miles of wire, and as soon as these are completed other lines will be installed.

HARTLAND, ONT., CAN.—John E. Stewart and A. B. Donworth are reported to be interested in a project to construct an electric railway from Hartland to Foreston, N. B.

LONDON, ONT., CAN.—The entire plant, franchise and equipment of the Southwestern Traction Company will be sold by auction on Oct. 20 at the London & Western Trust Company's offices. The company has 28 miles of track in operation.

ST. CATHERINES, ONT., CAN.—The Niagara, St. Catherines & Toronto Railway Company is in the market for material for its proposed extension from Welland to Port Colburne, which will require eight miles of single track. E. F. Seixas is general manager.

LONGUEIL, QUE., CAN.—The Montreal & Southern Counties Railway Company, of Montreal, has been granted a 24-year franchise to construct a street railway in Longueil. The railway will be 24 miles in length and will connect Montreal and St. Johns and intervening owns. Marcus S. Hill, 112 St. James Street, Montreal, is secretary of the company.

SWIFT CURRENT, SASK., CAN.—F. W. Laidley, of this town, is organizing a company to be known as the Saskatchewan Light, Heat & Power Company, and hopes to be able to start operations early next month.

New Industrial Companies.

THE AUTOMATIC COMPOUND ELECTRIC VEHICLE COMPANY, of Camden, N. J., has been chartered by L. E. Johnson, of Philadelphia, Pa., E. C. Waddington, of Woodstown, N. J., and L. Starr, of Woodbury, N. J. The company is capitalized at $100,000, and proposes to manufacture automobiles, etc., and deal in trade-marks, patents, etc.

THE BARR & CREELMAN COMPANY, of Rochester, N. Y., has been chartered, with a capital stock of $100,000, by J. A. Creelman, W. J. Creelman, of Rochester, N. Y., and H. B. Fairman, of Victor, N. Y. The company proposes to do gas, electrical heating, ventilating and heating work.

THE CATARACT MOTOR COMPANY, of Paterson, N. J., has been chartered, with a capital stock of $350,000, for the purpose of manufacturing motor vehicles, engines, etc., by Louis A. Plaget, William H. Sherman, Forester W. Freeman, Harris J. Westerhoff and George E. Hannah, all of Paterson, N. J.

THE CLARK ENGINEERING COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $100,000 by F. M. Shive, S. E. Roberson and H. W. Davis, of Wilmington, Del.

THE EUREKA SALES COMPANY OF CHICAGO, of Jersey City, N. J., has been incorporated to manufacture hand and electrical vibrators, etc. The company is capitalized at $100,000 and the incorporators are: F. R. Muenzenberger, C. J. Muenzenberger and A. J. Muenzenberger.

THE GURNEY BALL BEARING COMPANY, of Jamestown, N. Y., has been incorporated, with a capital stock of $600,000, to manufacture machinery, bearings, ball bearings, etc. The incorporators are: A. W. Kettle, F. W. Gurney and W. H. Kidder, all of Jamestown, N. Y.

THE LEADER-BEERS ENGINEERING COMPANY, of Rochester, N. Y., has been incorporated by Roland E. Presinger, of Decatur, Ill., Leroy F. Beers and Arthur Berman, both of Rochester, N. Y. The company is capitalized at $10,000, and proposes to manufacture engines, boilers, machinery and tools, etc.

THE McCANN BROTHERS' CONSTRUCTION COMPANY, of Murphysboro, N. Y., has been incorporated for the purpose of doing general construction work. The company is capitalized at $40,000 and the incorporators are: P. S. McCann, J. McCann and C. McCann, of Murphysboro, Md.

THE MECHANICSVILLE SPECIALTY SUPPLY MANUFACTURING COMPANY, of Mechanicsville, N. Y., has been incorporated, with a capital stock of $1,000, by James R. Smith, Stephen Lee and Melville L. Welling, all of Mechanicsville. The company proposes to manufacture mechanical devices, exploit patented articles, etc.

THE MILLER MOTOR COMPANY, of New York, N. Y., has been incorporated by C. Miller, L. H. Cummings and G. W. Scheafer, all of New York, N. Y. The company is capitalized at $30,000 and proposes to manufacture the Miller rotary engine.

THE NOHE ELECTRIC RENOVATOR COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $25,000, for the purpose of manufacturing electrical devices. The incorporators are: G. Langhenry, A. W. Nohe and J. V. Crane.

THE OHIO ELECTRIC COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $75,000 by Henry P. Dodge, Rathbun Fuller, Henry E. Marvin, James Brown Bell and Robert E. Lee. This company will take over the business of the Ohio Electric Carriage Company, which has been in operation for some time.

THE RAILWAY AUTOMATIC MAIL DEVICE COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000, to manufacture railway supplies, by J. H. Dunn, R. W. Waugh and Percival Steele.

THE TRACTOR ENGINEERING COMPANY, of Trenton, N. J., has been incorporated with a capital stock of $60,000 for the purpose of doing a mechanical engineering business and to manufacture trucks, motor trucks, tractors, etc. The incorporators are. W. Balderson, J. W. Wartz and J. E. Mosher, all of Trenton, N. J.

THE VAN BUREN ENGINEERING COMPANY, of New York, N. Y., has been incorporated by George G. MacCracken, Daniel J. Haner and C. Raymond Weaver, all of New York, N. Y. The company is capitalized at $15,000 and proposes to manufacture machinery, power and excavating machinery and metal products used in arts and sciences, etc.

THE WARNER MANUFACTURING COMPANY, of Muncie, Ind., has incorporated, capitalized at $250,000. The company proposes to establish and equip a large plant to manufacture automobiles, automobile parts, engines, motors and electrical equipment of all kinds. Thomas W. Warner is president, and E. S. Janney, secretary of the company.

THE WASHINGTON ENGINE WORKS, of New York, N. Y., has been incorporated, with a capital stock of $50,000, by William A. White, Ada A. White, of West Hoboken, N. J., and Benjamin H. Oliver, of New York, N. Y. The company proposes to do an engineering business, manufacturing engines, boilers, etc.

Company Elections.

OZARK, ARK.—At the annual meeting of the Altus Gin Manufacturing & Improvement Company the following-named officers were elected: A. D. Reynolds, president; A. Berghler, vice-president; William Hill, secretary; L. R. A. Wallace, treasurer, and C. A. Gochenous, manager.

GARNETT, KAN.—At the annual meeting of the Garnett Electric Light Company, held recently, all the officers were re-elected.

New Incorporations.

WILMINGTON, DEL.—The Bullock Service Corporation has filed articles of incorporation with the Secretary of State. The company is capitalized at $1,000,000 and proposes to generate, buy, sell and deal in electricity, gas, water and other public commodities.

CARROLLTON, ILL.—Articles of incorporation have been filed for the Carrollton Electric Company by Orman Pierson, S. Elmer Pierson and Stuart Pierson. The company proposes to furnish light, heat and power. Orman Pierson was at one time treasurer of the Carrollton Heat, Light & Power Company.

MONTICELLO, IND.—The Tippecanoe & Monticello Interurban Railway Company has been chartered with a capital stock of $100,000 to construct and operate a system of suburban railways to connect Fowler, Lafayette, Battle Ground, Ash Grove, Delphi, Idaville, Burnettsville, Buffalo and Logansport. The incorporators are: Thomas W. O'Connor, Willis White, of Monticello; Charles E. Turner, of Detroit, Mich.; Joseph A. C. Blackburn and William B. Felker, of Rogers, Ark.

REDDINGTON, IND.—The Redding Township Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is placed at $3,000. The company proposes to build and operate a telephone system throughout the counties of Jackson, Jennings and Bartholomew in the State of Indiana. Thomas Gillespie, John Fox, William Rossett and John A. Maelimo are incorporators.

SOUTH BEND, IND.—The South Bend & Logansport Traction Company has been incorporated by Thomas P. Moredock, Virginius Nicar and P. J. Haulihan, of South Bend, Ind.; Henry F. Coleman, of Logansport, Ind., and David Pepper, Jr., of Philadelphia, Pa. The company is capitalized at $400,000 and proposes to construct an electric railway from South Bend to Logansport, via Plymouth and Rochester, 69½ miles in length.

DES MOINES, IA.—The Adel City Railway Company has been incorporated with a capital stock of $10,000 to construct an interurban railway from Des Moines to Adel, by D. A. Blanchard, L. M. Macy, W. B. Kinnick, Robert Pilmer, F. F. Flynn, B. J. Flynn, R. L. Parrish and H. A. Smith.

LOUISVILLE, KY.—The Kentucky Rapid Transit Company has been incorporated under the laws of Delaware for the purpose of taking over various traction companies and interurban railways in Kentucky. It will operate in Louisville, Lexington and Frankfort. The capital stock of the company is placed at $10,000,000. Samuel M. Clement, Jr., West End Trust Building, Philadelphia, Pa., and George S. Graham, of 42 Broadway, New York, N. Y., are interested in the company.

PORTLAND, MAINE.—The General Light & Power Company has been organized with a capital stock of $500,000 for the purpose of constructing and operating lighting and power plants, etc. The officers are: A. G. McPherson, president, and James R. Parsons, treasurer, both of Portland, Maine.

DALTON, MICH.—The Dalton Telephone Company has been incorporated to establish a telephone system in Dalton. The company is capitalized at $5,000 and E. F. Plunkett and C. C. Plant are directors.

GRAND RAPIDS, MICH.—Articles of incorporation have been filed for the three power companies as follows: The Little Muskegon Water Power Company, with a capital stock of $125,000; the Montcalm Electrical Company, capitalized at $75,000, and the Western Hydro-Electrical Company, with a capital stock of $500,000. Bruce Goodfellow, of Detroit, Mich., is trustee of the companies.

LANSING, MICH.—Articles of incorporation have been filed with the Secretary of State for the Kalamazoo Valley Hydraulic Power Company. The company is capitalized at $300,000 and proposes to furnish electricity for lamps and motors in the Kalamazoo Valley. E. W. Stone and H. J. Aldworth, of Allegan, Mich., are incorporators.

STEPHEN, MINN.—The McMahon Telephone Company has been incorporated with a capital stock of $25,000 by Richard McMahon, E. E. Johnson, Thomas B. McMahon and John Peterson.

LOUISVILLE, MISS.—Articles of incorporation have been filed for the Winston Telephone Company with a capital stock of $10,000 by G. W. Jones, J. D. Fulton and others.

GLASGOW, MO.—Preliminary plans are being prepared by Burns & McDonnell, consulting engineers, of Kansas City, Mo., for electric lighting, water works and sewerage system for Glasgow, Mo.

MILES CITY, MONT.—Articles of incorporation have been filed for the Buffalo Rapids Power Company by George Burt, Della M. Burt and H. E. Fearnall. The company is capitalized at $300,000 and proposes to utilize the waters of the Yellowstone River, by means of a ditch, to generate electricity, which will be transmitted along the Yellowstone River between Billings and Glendive for lamps and motors. Electricity will also be furnished to farmers along the route. A dam will be built in the Yellowstone, to cost about $250,000.

ALBANY, N. Y.—The Hudson Valley Telegraph Company of New York has been chartered to construct and operate telephone and telegraph lines throughout the State of New York, northward to Canada and through the Eastern States, Pennsylvania and New Jersey. The capital stock is placed at $25,000 and the directors are: James H. Ryan, P. F. Graue and Edward Kelly, of New York, N. Y.

PORT JERVIS, N. Y.—Articles of incorporation have been filed for the Port Jervis Traction Company to construct an electric railway about four miles in length in Port Jervis. The company is capitalized at $43,000, and the incorporators are: John E. Dilly, James Torney, of New York, N. Y., and Thomas H. Milson, of Paterson, N. J.

MARSHALL, N. C.—The W. T. Weaver Company, of Asheville, N. C., is reported to be planning the erection of a hydro-electric plant on French Broad River, near Marshall, where it is proposed to develop 5000-hp to be transmitted by electricity.

BARTON, N. D.—Articles of incorporation have been filed for the Barton Farmers' Telephone Company, with a capital stock of $25,000, by E. Erickson, C. Myhran, James Scott and others, all of Barton, N. D.

MUNICH, N. D.—The Rosehill Farmers Telephone Company has been chartered with a capital stock of $5,000 by John M. Enns, Isaac P. Toews, D. H. Unran, all of Rosehill.

CLEVELAND, OHIO.—Articles of incorporation have been filed for the People's Street Railway Company by Thomas Dolan, Miles Dodd, Hugh McConaghy, Robert Johnstone and Francis E. Cottier. The company is capitalized at $10,000 and proposes to construct an electric street railway in Cleveland.

FOREST, OHIO.—The Consumers' Electric Company has been incorporated, with a capital stock of $35,000, by E. B. King, A. K. Nier, C. B. Horn, M. S. Wilcox and A. C. Bowser.

WATERVILLE, OHIO.—The Waterville Light & Power Company has been chartered with a capital stock of $10,000 by Delmar Farnsworth and others.

ASHER, OKLA.—The St. Louis Rural Telephone Company has been incorporated with a capital stock of $2,500 by C. E. Boardman, W. S. Carson, J. W. Anthony, C. W. Williams and others.

CARNEGIE, OKLA.—The Spring Valley Rural Telephone Company has filed articles of incorporation with a capital stock of $2,000. The incorporators are: Charles Lunsford, S. A. Van Cleve, H. Kindblade, E. Okeson, of Carnegie, and Isaac Johnson, of Alden.

FEATHERSTON, OKLA.—The Featherston Telephone Company has been incorporated with a capital stock of $2,000 by M. J. Daniels, R. N. Daniels and William A. Daniels, all of Featherston.

MARSHFIELD, ORE.—Articles of incorporation have been filed for the Catching Inlet Telephone Company, with a capital stock of $500, by William I. Bonebrake, James S. Masters and Alfred Gunnell.

CLEONA, PA.—The Cleona Rural Telephone Company has been organized to construct a rural telephone line about 11 miles long, to erect a rural telephone system to connect with Bell telephone system at Lebanon. The officers are: G. Holzappel, president; H. S. Fegan, secretary, and A. H. Horst, treasurer and agent.

ALLENDALE, S. C.—The Farmers' & Merchants' Telephone Company has been chartered with a capital stock of $500.

SMITHVILLE, TENN.—The Smithville Home Telephone Company has been incorporated with a capital stock of $3,000 by T. W. Wade, J. H. Christian, W. H. Davis, W. T. Hayes and E. G. Dawson.

MEXIA, TEX.—The Mexia Telephone Company has been chartered with a capital stock of $12,500 by H. O. Cravens, Jack Womack and J. S. Smith.

GRUNDY, VA.—The Sandy Valley Telephone Company has been chartered with a capital stock of $4,000 and the following named officers: John A. Looney, of Grundy, Va., president; B. Belcher, of Artia, Va.,

vice-president; R. E. Elswick, of Mouth Card, Va., secretary and treasurer.

NEWPORT NEWS, VA.—The Newport News & Yorktown Railway Company has been chartered with a capital stock of $25,000 to construct a railway from Yorktown to Newport News, a distance of 20 miles. The officers are: W. T. Chapin, of Newport News, president; Alvah H. Martin, vice-president, and C. P. Jones, secretary and treasurer.

MADISON, WIS.—The Twelve Corner-Mackville Telephone Company has filed articles of incorporation with the Secretary of State with a capital stock of $10,000, to erect a telephone line from Appleton to Black Creek. The incorporators are: Martin Striegel, of Mackville; C. F. Tiedt and John L. Parkers, both of Twelve Corners.

Legal.

ADMISSIBILITY OF EVIDENCE IN ACTION AGAINST ELECTRIC LIGHT COMPANY.—The plaintiff in an action for damages against an electric light company testified that on the evening on which the injuries complained of were received he went upon a bridge over which one of the company's wires was strung for the purpose of getting the air. While there he was attracted by the sound of a graphophone, and went to the south side of the bridge, and while standing on the floor of the bridge, leaning on the rail, a puff of wind blew his hat off. He grabbed for it, and in so doing his hand came in contact with the wire. He was permitted to testify at the trial that he examined the wire early next morning and found it to be uninsulated and sagging about 18 in. The general rule is well settled that evidence of the subsequent condition of the place where the accident occurs is not admissible to show a negligent condition at the time of the injury, because the question of negligence is to be determined by the actual condition at the time of the injury. There are certain well-recognized qualifications and exceptions to this rule, but the facts of this case did not bring it within any of those exceptions. There was no evidence upon the part of the plaintiff or the other witnesses to the effect that the insulation of the wires was defective or sagged down from a foot or 18 in. at the time of the alleged injury at the point or place where the accident is alleged to have happened. It was clearly incumbent upon the plaintiff to show by competent evidence that the wire sagged or slacked at the time of the accident—otherwise there could be no recovery in the case. The condition of the wire on the day after the accident under the facts of this case was not legally sufficient proof of its location and condition at the time and at the point or place of injury. The testimony, therefore, was too remote and misleading, and presented an issue of negligence not involved in the case. For this and other errors the judgment against the company was reversed.—Annapolis Gas & Electric Light Company vs. Fredericks, Court of Appeals of Maryland, 72 Atl. Rep., 534.

POLE-LINE ACCOUNT AND CONCURRENT NEGLIGENCE.—A telephone company negligently maintained a telephone pole along a county road for 15 years, and until the part imbedded in the ground had become decayed. The wire which had been used to strengthen the pole had been cut and not replaced, and as plaintiff was driving along the road a third person cut a tree on adjoining land, which fell against the wires, putting a strain on the pole, which broke off at or near the surface of the ground and fell on plaintiff, causing injuries. It was held that the negligence of the telephone company in maintaining the pole in such condition concurred with the negligence of the person who felled the tree on the wire, within the rule that where an injury is the result of the concurrent negligence of two or more persons all are liable, jointly or severally, for the damage. A verdict for $3,750 was rendered against the company.

In Johnson v. Northwestern Telephone Exch. Co., 48 Minn., 433, 51 N. W., 225, the action was for an injury caused by the falling in a street in Minneapolis of one of the poles of the defendant, on which were suspended its line wires, which fall was, as alleged, due to the rotten and unsound condition of the pole (permitted to be so by the defendant's negligence, rendering it of insufficient strength to bear the weight of the wires suspended upon it. For the purpose of sustaining the pole and preventing it from falling, the defendant had extended a guy wire from the top of the pole to a building, to which the other end of the wire was attached with the license of the owner of the building. The owner of the building revoked the license and required the removal of the wires from the building. The defendant failed to remove the wires, and thereupon the owner of the building cut them, and the pole, deprived of the stay afforded by the guy wires, broke off near the ground and fell into the street, injuring the plaintiff. At the close of the evidence the trial court directed a verdict for the defendant, upon the apparent assumption that between the negligence of the defendant and the injury of the plaintiff there intervened an independent, adequate cause of the injury, to wit, the act of a third person, which it was said was what is termed in law the proximate cause of the injury. The Supreme Court held that it was a case of concurrent negligence, in which case each party guilty of negligence was liable for the result, and that the negligence of each as the proximate cause for the injury would not have occurred but for that negligence.—Pacific Telephone & Telegraph Company v. Parmenter, United States Circuit Court of Appeals, 170 Fed. Rep., 140.

Personal.

MR. T. C. MARTIN, editor of the *Electrical World*, has been appointed by Mayor McClellan as a member of the Hudson-Fulton Celebration Commission.

MR. W. A. SAWYER, recently manager of the Buffalo office of the Western Union Telegraph Company, has been appointed superintendent of the fourth district of the Eastern division of the Western Union Telegraph Company, with headquarters at Philadelphia.

MR. F. V. HENSHAW, the consulting electrical engineer, sailed last week on the *Mauretania* to look into various matters of technical interest on the other side. He will be in London two or three weeks.

MR. J. B. CRAWFORD has been appointed superintendent of the Winona Interurban Railway Company and will have charge of the operating department and the property controlled and leased by that company.

MR. GEORGE GRAY WARD, vice-president of the Commercial Cable Company, accompanied by Mrs. Ward, has just returned from a prolonged stay in Europe, where he has been engaged on important work connected with the interests of his company.

MR. FREDERICK SARGENT, of Sargent & Lundy, consulting engineers, and Mr. Frank J. Baker, vice-president of the North Shore Electric Company, both of Chicago, have returned home after a summer spent in Europe. Mr. Sargent, accompanied by Mr. Baker, examined a number of foreign electrical plants, and both gentlemen obtained much information and pleasure from their trip.

MR. FRANKLIN W. KOHLER, of Kohler Brothers, Chicago, will sail from New York on Oct. 1 for London, after a brief vacation spent in his native land. Mr. Kohler had been 15 months abroad before this flying trip homeward, and he has been successful in introducing the Kohler electric system of printing-press control in England, Germany, France and Austria. He is returning to this work, which will demand his attention for several years to come.

MR. CHARLES A. S. HOWLETT, president of the Electric Club, of Chicago, announced his resignation at the meeting of Sept. 15, owing to his removal to New York. Mr. Howlett has been president of the club since its organization, a year and a half ago, and the members received the news of his retirement with genuine regret. In submitting his resignation Mr. Howlett reviewed the history of the club briefly and urged a higher sense of personal responsibility on the part of the members. He predicted a bright future for the organization and made a number of recommendations, including the publication of stenographic reports; the adoption of a club emblem; co-operation with other societies in matters of public interest; correspondence with similar clubs with the idea of the formation of a federation of electric clubs with membership cards mutually recognized; permanent quarters; an increase in membership from 375 to 1000 by the efforts of a special subcommittee of the membership committee; co-operation with the city electrician to secure a substantial portion of the proceeds of the proposed issue in Chicago for street lighting extensions; reduction of the club's bank surplus by using a part of the money to further the membership campaign and to give more benefits to members; the formation of a glee club; an occasional debate instead of set address; meetings of committees at least twice a month with monthly reports, and the formation of a publicity committee to secure reports of meetings in the daily as well as the technical press. Mr. Howlett's resignation was accepted and he departed for his new field of labor with the best wishes of the members of the club. At a meeting of the board of managers of the club on Sept. 17 Mr. Howlett was voted a life membership as a token of appreciation for his efforts in behalf of the organization.

MR. C. A. S. HOWLETT.

Trade Publications.

FUSE WIRES.—The Harvard Electric Company, 60 West Van Buren Street, Chicago, Ill., has issued a booklet giving specific information relating to fuse wire strips and lengths. These devices are constructed in accordance with Underwriters' specifications.

WEIGHTED PUSH-BUTTON—GUY ANCHORS.—The Central Electric Company, Chicago, has issued a new circular descriptive of the new Central type weighted push-button for which several advantages are claimed. Its base is well protected so that it will not mar the desk and by means of a special name-plate the various buttons are readily selected. The same company is also sending out a new folder descriptive of guy anchors. This guy anchor is of the harpoon type, being driven in position by means of the ordinary sledge.

SIGN LIGHTING WITH TUNGSTEN LAMPS.—Probably no other branch of illumination has taken more rapid strides in the last few

years than sign lighting, and in this connection the tungsten lamp shows to especially good advantage. In Bulletin No. 4680, of the General Electric Company, this subject is discussed at considerable length and detail. The comparative cost of sign lighting with carbon and tungsten lamps is shown by means of curves, and the great superiority of the tungsten over the carbon lamp is clearly proved.

MOTOR STARTERS AND CONTROLLERS.—In a new edition of its perpetual catalog, the Ward Leonard Electric Co., Bronxville, N. Y., devotes Sections A 12 and A 13 to motor starters with no-voltage release, equipped with steps of resistance for speed control by field regulation with either 5 steps of field resistance or 16 steps of field resistance, and the same with overload circuit-breaker attachment. This is a new line of apparatus. Sections B 6, B 7, B 8 and B 9 apply to machine tool controllers, both reversing and non-reversing types, with face plate and resistance combined, or mounted separately, with armature control alone or armature and field control. These are also new designs.

"DRYING IN INDUSTRIAL PLANTS."—With this title the Green Fuel Economizer Company, Matteawan, N. Y., has issued a pamphlet describing a new method for calculating drying equipments. The first part of the treatise discusses the elementary theory of drying and then describes drying equipments as used in various industries. The latter contains a chapter on drying engineering and gives an original method for calculating the amount of air and steam required for drying a given material under prescribed conditions, which does not require an elaborate system of special tables, the calculations being performed with the aid of the ordinary steam tables and a table of humidity, both of which are included. The book should be of interest, not only to manufacturers who have drying work to do, but also to engineers who design and construct plants of this character.

Business Notes.

THE J. M. CARPENTER TAP & DIE CO., Pawtucket, R. I., announces that it has prepared and will furnish lists of the new A. S. M. E. standard taps and dies, of the U. S. Standard in other than regular pitches, and of V-thread taps and dies other than the U. S. Standard.

BRISTOL PITTSBURGH OFFICE.—The Bristol Company, Waterbury, Conn., has established an office in the Frick Building Annex, Pittsburgh, in order to look after the large trade that has developed in the Pittsburgh manufacturing district, particularly in connection with temperature and pressure recorders used in the iron and steel industry.

CRESCENT WIRE.—General C. Edward Murray, treasurer of the Crescent Insulated Wire & Cable Company, of Trenton, N. J., was in Chicago last week and made a call upon his representatives, the Metropolitan Electrical Supply Company, which carries large stocks of Crescent wire. General Murray is well satisfied with the business outlook for the fall and winter, and thinks everything looks favorable for rushing business all along the line.

THE ARROW ELECTRIC COMPANY, of Hartford, Conn., which recently purchased the plant and business of the Marshall Electric Company, of Hyde Park and Boston, Mass., is making arrangements to move the plant to Hartford. The Arrow Company has leased the ground floor and one-third of the upper floor at Capitol Avenue and Laurel Street, and now practically controls the whole building. The company will take possession of its new quarters in November, when it will move the equipment of the Marshall Company to Hartford. The company manufactures electrical goods, including switches, wires and other supplies.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED SEPT. 14, 1909.

[Conducted by W. F. Bissing. Patent Law, 2 Rector St., N. Y. City.]

933,737. VENTILATING PLATE AND SPACING BLOCK FOR ELECTRIC APPARATUS; J. A. Baird, Pittsburgh, Pa. App. filed Nov. 3, 1906. The plate has groups of holes with spacing blocks having dove-tailed projections, and a locking device is provided consisting of a portion of the plate adjacent to one hole, which may be deflected to permit the dove-tailed projection to enter the ventilating hole.

933,746. OVERLOAD AND REVERSE CURRENT RELAY DEVICE; F. Conrad, Edgewood Park, Pa. App. filed May 8, 1905. Operates the circuit protective apparatus when the direction of the drop of potential becomes reversed or when the current exceeds a certain amount by providing a governor consisting of an electro-magnet operating a rotatable member, the magnet being provided with a series of windings so as to be actuated by electric forces proportional to the current, voltage and certain other factors of the circuit.

933,747. OVERHEAD LINE MATERIAL FOR ELECTRICAL RAILWAYS; H. P. Davis, Pittsburgh, Pa. App. filed Nov. 8, 1907. A section break insulator comprising an insulating bar having end brackets with wire-clamping devices and switch jaws, intermediate members and switch blades pivotally mounted thereon and adapted to engage the switch jaws on either end bracket.

933,756. ELECTRIC SIGNAL; W. K. Howe, Rochester, N. Y. App. filed March 18, 1908. Makes use of two lights with an oscillating disk to cover and uncover the lights, a counterbalanced arm, driven by a gear and pinion from an electric motor with a friction clutch member in the train of connections.

933,765. WINDING FOR ARMATURE OF DYNAMO-ELECTRIC MACHINES; B. G. Lamme, Pittsburgh, Pa. App. filed Nov. 3, 1906. A dynamo with a variable number of poles having a winding for the armature with a pitch between the coils which is intermediate that of the polar pitches for the respective different numbers of poles.

933,766. VENTILATING PLATE FOR LAMINATED STRUCTURES; P. A. Lange, Manchester, Eng. App. filed Feb. 20, 1907. Spacing ribs are secured to the ventilating plates by a special construction of rivets.

933,767. ALTERNATING-CURRENT TRANSFORMER REGULATOR; A. C. Lasher, Wilkinsburg, Pa. App. filed Nov. 26, 1906. The ventilator contains a movable coil whose weight is used to bring the movable coil adjacent to the fixed coil in opposition to the electromagnetic repelling force between the coils.

933,769. ARC LAMP HAVING MAGNETIZABLE ELECTRODES; G. M. Little, Pittsburgh, Pa. App. filed May 10, 1906. The electrode contains magnetizable material and a magnet winding surrounds it and is connected in series with it.

933,770. ARC LAMP; G. M. Little, Pittsburgh, Pa. App. filed May 10, 1906. The electrode has an enclosing casing with vanes for directing a draft of air upon the inner surface of the casing, at the same time rotating the air.

933,787. FUSE RECEPTACLE; B. P. Rowe, Wilkinsburg, and S. M. Kintner, Pittsburgh, Pa. App. filed Sept. 20, 1906. For high-potential circuits in which a hollow insulator containing insulating fluid also contains an enclosed fuse located in the fluid.

933,702. COIL-WINDING APPARATUS; H. B. Smith, Worcester, Mass. App. filed May 9, 1907. The coil winder has a cylindrical form mounted on a horizontal axis and a removable sleeve, with a ring fitted over the sleeve.

933,800. SECTION-BREAK INSULATOR; T. Varney, Pittsburgh, Pa. App. filed June 4, 1906. For bow trolleys in which end clamps and parallel sectional side bars of insulating material are used, the sections being clamped together and the conductors being connected to the end clamps and extending along the side bars.

933,802. RAILWAY LIGHTING AND SIGNALING DEVICE; C. A. Ward, Forestville, Conn. App. filed June 19, 1907. Safety devices for railway trains and for lighting the roadway adjoining the track during the travel of the train. Uses separate lighting wires alongside of the main wire with lights connected with each lighting wire and a trolley pole having supplementary wheels for engaging the lighting wire.

933,815. ELECTRIC FURNACE; T. F. Baily, Alliance, Ohio. App. filed Oct. 13, 1908. A furnace with non-metallic walls, electrodes and a resistance body located at the bottom of the heating chamber. Specific construction of walls.

933,824. TELEPHONE STAND; C. S. Coom, Rockledge, Pa. App. filed April 8, 1909. For handling a receiver, freeing the hands, by providing a bent arm controlling the switches and carrying a round socket in which a fork is mounted, the fork holding the receiver.

933,826. INTERMITTENT LINE SWITCH; E. E. F. Creighton, Schenectady, N. Y. App. filed Oct. 31, 1907. A lightning arrester made up of a plurality of aluminum cells, spark gaps in series therewith and switch blades adapted to close the gaps, with means for simultaneously and periodically actuating the blades.

933,827. ADJUNCT FOR ALUMINUM CELL LIGHTNING ARRESTERS; E. E. F. Creighton, Schenectady, N. Y. App. filed Aug. 7, 1907. An electrolytic condenser lightning arrester having a resistance in series with it and a high resistance shunt in parallel with the resistance.

933,843. METALLURGICAL CONDENSER; W. McA. Johnson, La Harpe, Kan. App. filed Nov. 30, 1903. The walls of the condensing chamber are heated by carbon heaters electrically actuated.

933,845. ARRANGEMENT FOR INDICATING AND RECORDING PERMANENTLY THE MAXIMUM DEMAND FOR ELECTRICAL ENERGY ON ANY CIRCUIT; W. W. Lackie and D. J. Steele, Glasgow, Scotland. App. filed Jan. 31, 1908. The indicating means include a solenoid operating wheel and provided with a weight for resisting its rotation and a pivotally mounted cross-bar upon which the wheel is mounted with a magnetic plunger within the solenoid moving the cross-bar to bring the wheel into engagement with the meter.

933,861. ART OF WATERPROOFING FIBROUS MATERIALS; A. O. Tate, Toronto, Canada. App. filed June 1, 1907. Permeates the interior fibers with a saponaceous substance and electrolytically coats the surface of the material with palmate of aluminum.

933,871. RAILWAY TRACK INSTRUMENT; H. M. Abernethy, Cleveland, Ohio. App. filed Jan. 16, 1907. Has a box in which electric contacts are supported and a disk which is rotated by the movement of the railway switch for connecting and disconnecting the contacts.

933,887. CLUSTER FIXTURE FOR ELECTRIC LIGHTS; J. H. Caldwell, Philadelphia, Pa. App. filed Oct. 21, 1908. A hanger and base with lamp sockets on the base, a switch on the base and a shade surrounding it.

933,899. ELECTRICALLY OPERATED CLOCK; H. Gillette, Chicago, Ill. App. filed March 11, 1908. An electrically actuated clock comprising a master clock and a secondary clock with a rotating circuit-closer, electrical means controlled by the master clock moving the circuit-closer to close the circuit and means actuated by a motor to impart another movement to the circuit-closer to open the circuit.

933,930. ELECTROMAGNETIC SEPARATOR FOR GRAIN CHUTES; B. M. Sypher, Toledo, Ohio. App. filed June 22, 1908. For separating out the magnetic particles which may be mingled with the grain by arranging an electromagnet within a chute. Details.

933,944. METHOD FOR MAKING PURE UNCTUOUS GRAPHITE; Edward Goodrich Acheson, Niagara Falls, Ontario, Canada. App. filed May 10, 1909. Electrically heats a body of carbonaceous material, surrounding the mass by an envelope of sand and carbon.

933,956. ELECTRICAL SWITCH; F. H. Buffehr, Millers, Nev. App. filed May 3, 1909. All the parts are mounted inside of a casing which has a cover and in which is placed a drum provided with a plurality of contacts, an operating handle, and apertures in the cover for the terminal wires.

933,989. ELECTRIC HEATER: C. E. Johnson, Los Angeles, Cal. App. filed Jan. 22, 1909. A continuous blast of air is forced by a fan against a set of heating wires, heated electrically, in front of the fan.

934,024. INCANDESCENT LAMP; E. H. Smith, Aberdeen, Wash. App. filed Nov. 30, 1908. A multiple-filament lamp with a switch lever operated by two strings so as to throw in either filament. Details.

934,085. SYSTEM FOR BRAKING MOVABLE PLATFORMS: C. C. De Mocomble, Paris, France. App. filed Dec. 22, 1906. The platforms are moved by rollers on rails and the trucks are joined to form a continuous platform. The platform is stopped when an obstacle gets in the way by means of a solenoid which actuates an interrupter that breaks the motor circuit.

934,097. CONTROLLER FOR ELECTRIC MOTORS; F. L. Sessions, Columbus, Ohio. App. filed Jan. 31, 1908. A series of stationary contacts, a series of movable contracts, rocking holders for the latter mounted on swinging arms and a series of rotary cams each arranged to engage directly with one of the rocking holders.

934,104. CONTROLLING MEANS FOR ELECTRICAL CLUTCH-DRIVING MECHANISM; A. P. Stekel, Buffalo, N. Y. App. filed Dec. 11, 1908. For elevators using several drives from one line shaft. Makes use of two electric clutches with means for exciting either clutch and means operated by the motion of the machinery when the current is cut off from the driving clutch for exciting the other clutch whereby the latter clutch retards the motion.

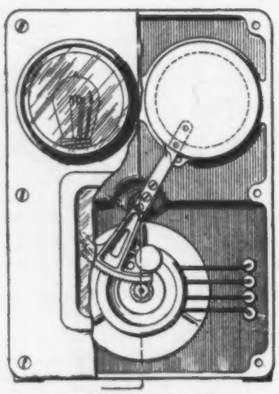
934,108. ELECTRIC BURGLAR ALARM; M. Trautmann, Dresden, Germany. App. filed Nov. 21, 1908. A curtain is suspended in front of the entrance to be guarded and consists of conductively connected flexible members, with two series of contact elements.

934,119. CIGAR LIGHTER; F. J. Wildemann, Newark, N. J. App. filed Feb. 10, 1909. Comprises a base, a lamp on the lid, together with a swinging arm whose end engages the lamp to form a spark.

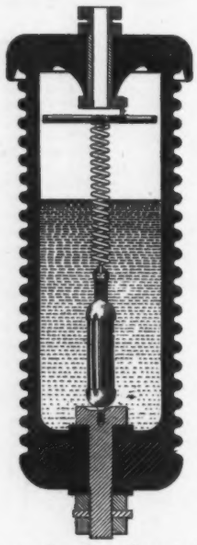
934,170. METHOD OF REDUCING ORES; Karl Albert Fredrik Hiorth, Christiana, Norway. App. filed Feb. 10, 1908. Mixes the ore with graphite rock containing silica and a basic material and subjects the mixture to an electric current.

934,210. DYNAMO-ELECTRIC MACHINE: W. D. Pomeroy, Norwood, Ohio. App. filed March 6, 1905. The dynamo has a laminated core with dove-tailed connection between the core and frame and clamping bolts holding the laminae together.

934,211. SPEED-LIMITING DEVICE: W. D. Pomeroy, Norwood, Ohio, and A. L. McHugh, Cincinnati, Ohio. App. filed March 9, 1905. The dynamo has a circuit-breaker and a speed-limiting device comprising a switch controlling the circuit breaker and operated by a centrifugal device.



933,756—Electric Signal.



933,787—Fuse Receptacle.

934,212. KNOCKDOWN ARMATURE; E. W. Presbrey, New York, N. Y. App. filed May 19, 1908. Made up of soft iron pole cheeks arranged about a common axis, a soft iron laminated core between the cheeks secured by a screw extending between the cheeks and core.

934,225. FIRE AND TEMPERATURE ALARM OR INDICATOR; C. Smith, South Croydon, England. App. filed Sept. 11, 1908. An automatic alarm in which the burning of a cord permits a weight to drop and close the circuit.

934,232. CONTROLLER HANDLE; E. W. Stull, Norwood, Ohio. App. filed June 22, 1905. Controller handle carries a pawl and a notched member with which the pawl engages with means for causing the pawl to engage one of the notches when the handle is moved forward and releasing it when moved slightly backward, together with means for preventing the pawl from engaging the same notch when the handle is moved forward.

934,233. CONTROLLER HANDLE; E. W. Stull, Norwood, Ohio. App. filed June 22, 1905. See 934,232. A form of controller which can be moved forward at any desired rate of speed in case of an emergency.

934,236. PULL SOCKET; G. B. Thomas, Bridgeport, Conn. App. filed May 15, 1909. A rotary insulating block carries a switch mounted on a spindle, which spindle is operated by a cord so as to rotate the block.

934,255. WALL DISTRIBUTING RING FOR TELEPHONE CONSTRUCTIONS; J. H. Wilson, Rome, Ga. App. filed Dec. 2, 1908. For carrying wires from cable terminals to subscribers' stations, consisting of a ring for holding the cables made of a bent piece of wire, one end provided with a screw to screw into the wall and the other with a loop to carry the cable.

934,256. DYNAMO-ELECTRIC MACHINE: A. H. Wouters, Norwood, Ohio. App. filed March 1, 1907. The stator winding of a multipole polyphase alternating-current machine has connectors for certain of the coils made of arc shaped strap conductors side by side, insulating members between the conductors and axial bolts for securing the parts together.

934,278. METHOD OF MANUFACTURING NICKEL AND NICKEL-COPPER ALLOYS; David Henry Browne, Copper Cliff, Ontario. App. filed Feb. 11, 1909. Fuses sulphur compounds of nickel by electric heat in the presence of lime.

934,281. AUTOMATIC TEMPERATURE INDICATOR; W. E. Campbell, Chester, S. C. App. filed April 14, 1909. For exposed water pipes to prevent freezing in which a contractable wire closes the circuit at certain temperatures to give an alarm.

934,284. ELECTRIC SIGNALING DEVICE; R. V. Cheatham, St. Matthews, Ky. App. filed March 31, 1908. A warning signal for tracks on railways operated by an electromagnet and having a time movement for automatically interrupting the signal-operating circuit after a predetermined interval.

934,296. TUNER FOR WIRELESS TELEGRAPHY; H. Dunwoody, United States Army. App. filed July 5, 1907. Combines a plurality of pairs of coils with an aerial, one pair slidingly and the other angularly adjusted, relatively to the other, the number of turns remaining constant.

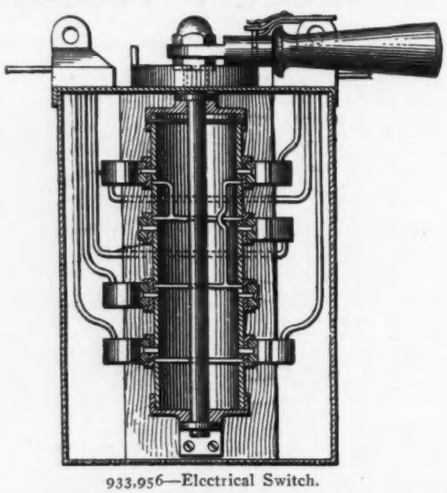
934,298. OUTLET BOX; T. J. Fagen and Samuel C. Thomason, Baltimore, Md. App. filed Sept. 25, 1908. The casing is formed of sections with a central collar within the casing and openings in its walls.

934,301. CONTROLLING DEVICE FOR ELECTRIC MOTORS; E. H. Geist, Cologne, Germany. App. filed Nov. 16, 1908. For cranes in which a field winding on the generator is in series with the armature, the armature of the motor to be regulated being in series with the generator armature. Uses a shunt field on the generator, a switch and connections for throwing the field and armature circuits of the generator into circuit and for inserting and removing the resistances from the circuit of the second field.

934,352. LINE WIRE CONNECTOR; J. S. Pratt, United Sates Army. App. filed Nov. 24, 1908. Comprises a curved strip providing terminal hooks with a lateral rib on the curved portion of the strip.

934,369. VENTILATING PLATE AND SPACER FOR ELECTRIC APPARATUS; H. D. Summers, Wilkinsburg, Pa. App. filed Oct. 24, 1906. The plate has oblong holes and carries ribs projecting from the sides of the plate to produce the spacing and ventilating action.

934,379. PROCESS OF PRODUCING CALCIUM SILICID; T. L. Willson and M. Hadd, Ottawa, Canada. App. filed April 2, 1900. Subjects calcium carbon, silica and carbon to an electric arc.



933,956—Electrical Switch.

934,385. APPARATUS FOR ELECTROLYSIS OF ALKALI CHLORIDS; J. Billitzer, Vienna, Austria-Hungary. App. filed June 17, 1908. Arranges an anode above a cathode horizontally with a horizontal diaphragm between them, thus forming layers and diminishing the density of the anode solution. Causes the lower heavier layer to flow out by means of a dam.

934,390. OVERLOAD AND REVERSE CURRENT RELAY DEVICE; F. Conrad, Swissvale, Pa. App. filed Oct. 24, 1906. A relay operated by a reversal of the drop of potential or when the current exceeds a certain amount. It consists of a magnetizable core having a yoke and polar faces adjacent to the conducting member, a magnetizing winding located on the yoke of the core, with a second winding located on the yoke, and a third winding located on the polar extremities of the core, the last named being supplied with a voltage proportional to that of the supply circuit.

934,391. OVERLOAD AND REVERSE CURRENT RELAY DEVICE; F. Conrad, Swissvale. Pa. App. filed March 15, 1909. See 934,390. Combines a movable conducting member, a magnetizable core having a yoke and pole pieces, a winding located on the yoke of the core, a winding surrounding the reduced portions of the pole pieces and closed-circuit windings surrounding the pole-piece projections.

934,396. SIGNAL BELL; H. W. Eden, Detroit, Mich. App. filed Dec. 7, 1908. A frame for electric bells by means of which the spool may be interchanged with either of two varieties of bell brackets. Combines a pair of spools with independent frame members.

934,405. DYNAMO-ELECTRIC MACHINE; L. J. Hunt, Sandycroft, near Chester, England. App. filed May 20, 1907. Combines upon a single stator and rotor the windings of an induction motor and those of an alternating-current commutator motor, which may be either a series motor, a repulsion motor or a series repulsion motor.

934,421. INDICATOR FOR SWITCHES; C. A. Clark, Hartford, Conn. App. filed Sept. 21, 1908. An indicator for switches of the snap switch type, so as to visually indicate the position of the switch. Details.

13,020. APPARATUS FOR REFINING COPPER; F. L. Antisell, New York, N. Y. App. filed April 3, 1908. For electrolytically refining copper and saving the silver, by providing a diaphragm suspended in the electrolyte with a removable wooden panel carried by the frame. (Reissue.)